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MONTANA FISH AND GAME DIVISION
FISHERIES DIVISION

JOB COMPLETION REPORT
RESEARCH PROJECT SEGMENT

29
#3

State of Montana

Name: Western Montana Fishery Study

Project No.: F-12-R-9

Title: Population Survey of Rattlesnake Creek, O'Brien Creek, and Flower Creek

Job No.: 5

Period Covered: July 1, 1962 through June 30, 1963

ABSTRACT:

The population census by electrofishing was continued on all three streams. Findings in Flower Creek indicated that Section 2 populations were about the same in 1962 as in 1960, but that the catch was down in Section 1 in 1962. Each section was 300 feet long. The decrease in catch in Section 1 was probably caused by bridge construction involving disturbance of the creek.

The sampling of Rattlesnake Creek indicated that the trout population had recovered from a "peak" and "valley" that occurred in 1960. There are indications of another "peak population" build-up.

O'Brien Creek was opened to angling May 20, 1962, for the first time in over thirty years. Limited creel census indicated that fishing success was good; the catch-per-man-hour was 1.13. The creel consisted of three cutthroat to every brook trout. The cutthroat averaged one-half inch larger than the brook trout.

Population sampling in 1961 showed that catchable-sized (7" or longer) brook trout outnumbered cutthroat by a ratio of 1.1:1. Sampling in 1962 after the bulk of the fishing season showed that the catchable-sized brook trout outnumbered the same size cutthroat by 4.3:1.

RECOMMENDATIONS:

Work load for the next segment of Project F-12-R are estimated to be great and will allow for only small amounts of time to be spent on this particular job. Therefore, it is recommended that the creel census on O'Brien Creek, and the sampling of Rattlesnake Creek and Flower Creek be discontinued for the coming period. The latter two streams should be resampled in 1964-65 and efforts made to open them to fishing. O'Brien Creek should be sampled in the fall of 1963.

OBJECTIVES:

Rattlesnake Creek, O'Brien Creek, and Flower Creek are respectively sources of domestic water for the towns of Missoula, Troy, and Libby, Montana. As such these streams were closed to angling for at least the past thirty years prior to the initiation of this study. It was assumed they were at near "natural" condition. Long term objectives of this study were to measure the fish populations in

their natural state, open the streams to angling and measure the changes occurring in their fish populations.

Objectives for this report period were to continue the population sampling on all three streams. One stream, O'Brien Creek, was opened to angling commencing with the 1962 Montana general angling season. Creel census information was to be collected from anglers fishing O'Brien Creek on selected week-end days during the fishing season.

TECHNIQUES USED:

The fish populations of O'Brien Creek, Flower Creek, and Rattlesnake Creek were each sampled during the report period. Techniques and sampling sites were the same as those used in 1961 and are described by Huston (1962)1/. Creel census information was collected from anglers fishing O'Brien Creek on seven week-end days during the 1962 Montana general fishing season. Check stations were operated on the principal road(s) leading out of the fishing area(s). Information collected included hours fished, number of fish caught by length and species, and lure used.

Descriptions of the physical and chemical characteristics of the three streams and a dissertation upon the biological data collected in 1960 and 1961 are given by Huston (1961 2/ 1962 1/).

Findings: O'Brien Creek

Species of fish collected from O'Brien Creek include the cutthroat trout (*Salmo clarki*), brook trout (*Salvelinus fontinalis*), Dolly Varden (*Salvelinus malma*), and rainbow trout (*Salmo gairdneri*). Rainbow trout are found only in Section 1 and Dolly Varden in Section 5 (Figure 1). The Dolly Varden, thought to be transients from the Kootenai River, do not contribute much to the population, or to the creel and therefore will not be mentioned further.

The data collected from the 1962 sampling is given in Table 1 and is compared to data collected in 1960 and 1961 from the same sections. The 1962 data represents the stream population following one year of angling pressure while the earlier data represents the stream population prior to legal angling.

1/ Huston, Joe E. 1962. Population Survey of Rattlesnake Creek, O'Brien Creek, and Flower Creek. Job Completion Report, Project F-12-R-8, Job #2, Montana Fish and Game Department.

2/ Huston, Joe E. 1961. Population Survey of Rattlesnake Creek, O'Brien Creek, and Flower Creek. Job Completion Report, Project F-12-R-7, Job #2, Montana Fish and Game Department.

Figure 1. O'Brien Creek Sampling Sections and Creel Census Stations

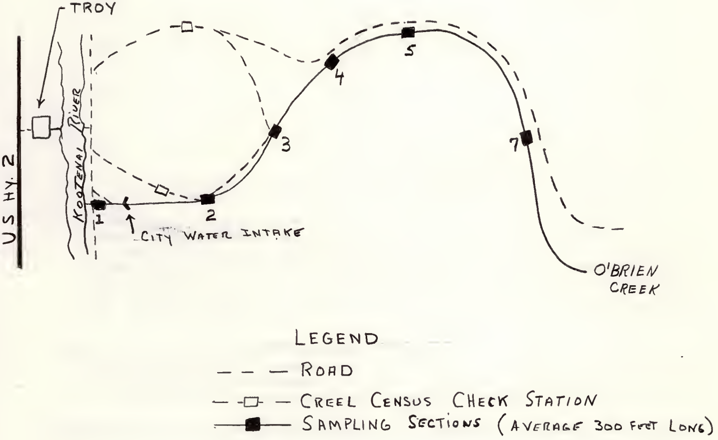


Table 1. ELECTROFISHING CATCH BY SECTIONS, O'BRIEN CREEK, 1960, 1961 and 1962

Section	Years Sampled	Cutthroat No.	Cutthroat Lb.	Brook No.	Brook Lb.	Rainbow No.	Rainbow Lb.	Total (Average) No.	Total (Average) Lb.
1	'60-'61 1/	8	0.65	5	0.45	4	0.42	17	1.52
1	'62	7	0.34					7	0.34
2	'61	27	2.22	11	0.42			38	2.64
2	'62	21	0.82	5	0.24			26	1.06
3	'60-'61	27	2.48	19	0.92			46	3.40
3	'62	16	0.55	17	0.84			33	1.39
4	'61	25	1.87	81	4.07			106	5.94
4	'62	21	1.21	78	4.31			99	5.52
5	'60-'61	28	5.23	15	0.42			43	5.65
5	'62	4	1.39	8	0.31			12	1.70
6	'61			73	6.11			73	6.11
6	'62			107	5.47			107	5.47

1/ Data given for '60-'61 is an average for the two years.

These data show a general decrease in numbers and weight of cutthroat trout taken from all sections except Section 6 where cutthroat do not occur. The numbers and/or weight of brook trout show little change in Sections 3, 4, and 6; whereas a change is evident in Sections 1, 2, and 5. The area around Sections 2, 3 and 5 is the most heavily fished portion of the stream. This angling factor may account for the decrease in the population count for both the cutthroat and brook trout.

A further analysis of the population sampling with respect to size of fish taken is given in Table 2. Table 2 gives the number of fish by species of a catchable size per mile of stream. Data is presented for 1960, 1961, and 1962. Fish seven inches or longer have been placed in the catchable-size class.

Table 2. TOTAL NUMBER AND NUMBER OF CATCHABLE-SIZE FISH PER MILE OF STREAM ABOVE WATER INTAKE, O'BRIEN CREEK, 1960, 1961, and 1962

	Brook Trout			Cutthroat Trout		
	1960	1961	1962	1960	1961	1962
Number of Fish	457	784	886	372	449	264
Number of Catchables	49	119	90	159	106	21
Percent Catchables	11%	15%	10%	43%	24%	8%

The data in Table 2 show that the total number of brook trout has increased yearly and that there is a 19 percent drop in the number of catchable-sized brooks from 1961 to 1962. This may or may not be a significant change. The total numbers of cutthroat trout rose in 1961 over 1960 along with the brook trout increase, but in 1962 the number of cutthroat per mile fell considerable whereas the brook trout numbers increased. The numbers of catchable-sized cutthroat has decreased each year, but with a most marked decrease in 1962.

The O'Brien Creek population sampling has been conducted in the fall each year. This sampling falls near the end of the angling season and well past the peak summer fishing. This sampling time should show or indicate the effects of a fishery upon the fish population more readily than if the sampling were done in the summer.

In 1962 creel census was taken on seven week-end days from the opening of fishing May 20th through Labor Day, September 2. The catch data from this census is presented in Table 3.

Table 3. CENSUS INFORMATION, O'BRIEN CREEK, 1962

Number of Anglers	Catch/Man-hour	Cutthroat-Aver.Size		Brook-Aver.Size	
75	1.13	181	8.3"	59	7.8"

Catch per man-hour, artificial lures and flies - 2.42
Catch per man-hour, natural baits - - - - - - 1.05

In general anglers using artificial lures and flies were more successful than those using natural baits. In addition the former type of angling was rewarded with a creel composed mainly of cutthroat trout while the latter anglers creel contained many brook trout. Anglers using artificial lures and flies were outnumbered by those using natural lures 1:1.7.

The catch data show that cutthroat trout comprised the bulk of the angler creel. The 1962 population data also show that cutthroat trout make up a smaller portion of the total population than do the brook trout, whereas a year earlier the number of catchable cutthroat about equalled the number of catchable brook trout. In 1962 the number of brook trout, all sizes included, is also greater than the total number of cutthroat.

Findings: Flower Creek

Both sections sampled in Flower Creek lie in the stream area closed to angling. A comparison of the electrofishing catch by section by year is given in Table 4.

Table 4. CATCH OF TROUT BY SECTION, FLOWER CREEK, 1960 and 1962

Section	Year	Cutthroat No.	Cutthroat Lb.	Rainbow No.	Rainbow Lb.	Brook No.	Brook Lb.	Dolly Varden No.	Dolly Varden Lb.	Total No.	Total Lb.
1	1960	18	2.62	3	0.37	9	0.74	4	0.33	34	4.06
1	1962	17	1.30	2	0.18	2	0.22	1	0.15	22	1.85
2	1960	37	2.09	2	0.44					39	2.53
2	1962	32	2.62	1	0.04					33	2.66

These data show that no great changes have occurred in the over-all trout population of Section 2 during the years sampled but that changes have occurred in Section 1. Many or all of the changes present in Section 1 might be attributed to construction of a new bridge that resulted in some channel changing and siltation.

Findings: Rattlesnake Creek

Rattlesnake Creek is divided into three areas. Area A takes in the stream below the Montana Power dam; this portion has been open to angling in previous years and contains rainbow trout, brook trout, cutthroat trout, Dolly Varden, and sculpins (*Cottus* sp.). Area B and C lie above the Montana Power dam in the stream area closed to angling. Species of fish found in Area B include the same as those found in Area A. Only rainbow trout, cutthroat trout, and Dolly Varden are found in Area C. Figure 2 shows areas and sampling stations on Rattlesnake Creek.

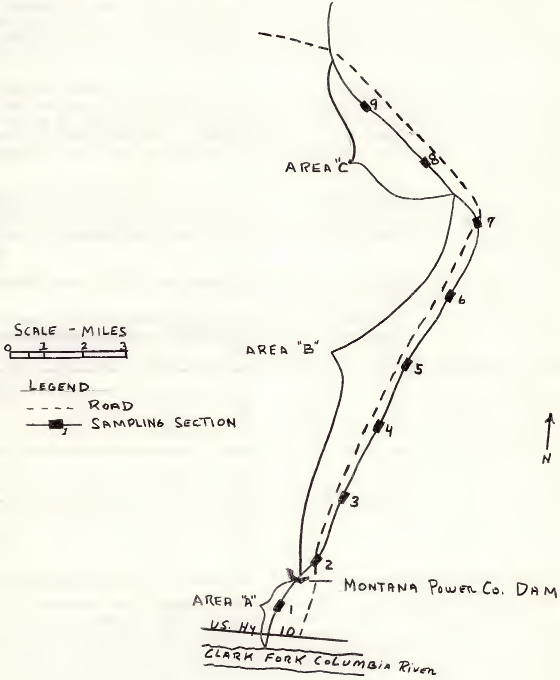
The average catch per section by Area is presented in Table 5. Data are given for all sampling done since the inception of this study in February, 1960. Discussion of population dynamics will be limited generally to the two most important species: brook and cutthroat trout.

Table 5. AVERAGE CATCH OF TROUT PER SECTION BY AREA, DATE, AND SPECIES, RATTLESNAKE CREEK, 1960, 1961, and 1962

Date	Area	Cutthroat No.	Cutthroat Lbs.	Brook No.	Brook Lbs.	D. Varden No.	D. Varden Lbs.	Rainbow No.	Rainbow Lbs.	Total No.	Total Lbs.
Aug.'60	A1/	8	0.81	12	0.63	4	0.21	6	0.39	30	2.04
Aug.'61	A	9	0.60	6	0.50	6	0.23	17	1.35	37	2.68
Aug.'62	A	5	0.74	19	1.27	-	----	12	1.11	36	3.12
Feb.'60	B	18.3	7.54	12.5	1.48	3.8	1.11	1.5	0.39	36.1	10.51
Aug.'60	B	28.3	8.91	17.2	1.57	7.7	1.75	5.2	1.31	58.7	13.54
Mar.'61	B	15.8	3.93	8.5	0.66	5.0	0.49	2.5	0.26	31.8	5.34
Aug.'61	B	21.0	4.81	10.8	1.21	4.8	0.65	4.0	0.35	40.6	7.02
Aug.'62	B	34.5	6.36	21.0	1.70	8.5	1.84	4.7	0.75	68.7	10.65
Aug.'60	C	23.0	4.92			14.5	2.39	2.0	0.28	39.5	7.59
Aug.'61	C	27.5	2.83			25.5	2.45	5.5	1.04	58.5	6.32
Aug.'62	C	30.0	3.61			12.0	1.05	1.5	0.32	43.5	4.98

1/Data for each area is the average of the sections in that area.

Figure 2. Rattlesnake Creek areas and sampling sections.



The data for Area A show a somewhat stable population with respect to total numbers of fish taken along with an increase in the average size of the individual fish. Cutthroat taken from Area C have increased in numbers throughout the study, but the weight of the catch declined from 1960 to 1961 and then increased again in 1962. The numbers and weight of rainbow and Dolly Varden trout rose in 1961 compared to the 1960 population and then fell again in 1962. The total number of fish taken in 1962 is greater than the total in 1960 but the weight is much less.

The fluctuation in numbers between the various sampling times is apparent for all species of game fish found in Area B. These data may indicate that the Area B population reached a peak in the summer of 1960, fell into a slump the following year and recovered by the summer of 1962. Less fish but of a greater size were present in 1960 as compared to 1962 when more fish but of a smaller size were sampled.

A frequency distribution based upon both age and size of fish is presented in Table 6. These data are derived from Sections 2 through 7, Area B, for all August samplings. Individual fish were assigned ages using age-growth data given by Huston (1961)3/.

Table 6. AGE-LENGTH DISTRIBUTION OF CUTTHROAT AND BROOK TROUT TAKEN FROM AREA B, AUGUST 1960, 1961 and 1962.

			Age and Length					
		Total	I	II	III	IV	V	VI
Species	Date	Catch	0 - 3"	3 - 6"	6 - 9"	9 - 12"	12 - 15"	15 - 18"
Cut-throat	'60	170	>1%	27%	23%	38%	11%	>1%
	'61	126	5	41	24	19	10	1
	'62	207	2	41	32	20	5	-
			I	II	III	IV	V	VI
			2 - 4'	4 - 6"	6 - 8"	8 - 10"	10 - 12"	12 - 14"
Brook	'60	103	8%	58%	21%	12%	1%	-
	'61	65	9	49	33	8	-	1%
	'62	126	9	52	31	8	-	-

The data in the above table show the basic changes that occurred in the population of cutthroat trout and brook trout from 1960 to 1962. In 1960, 49 percent of the cutthroat sampled were larger than nine inches total length. In 1961 and in 1962 only 30 and 25 percent of the sample were over nine inches in length. Between the 1960 and 1961 population sampling the number and percentage of four year old and older fish was reduced. From 1961 to 1962 two-year old fish became predominate in the catch. The catch of 1962 shows that fish of

3/ Huston, Joe E. 1961. Op. cit.

age-classes III and IV are more numerous than in 1961, but fish of age-class V and VI are less abundant. These trends may indicate that conditions similar to 1960 may occur again 1963 or 1964.

The brook trout data show a general increase in population numbers following 1960 with about equal percentage changes in all age-groups. Small differences exist between 1960 age-groups II, III, and IV with the following years. It does not appear that brook trout in this section are subject to variations in the age-class composition, but rather are subject to variations in numbers with the variation being equally distributed throughout all age-classes.

Prepared by Joe E. Huston

Approved by George D. Holton

Date November 21, 1963

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JOB COMPLETION REPORT
RESEARCH PROJECT SEGMENT

State of Montana

Project No.: F-12-R-9

Name Western Montana Fishery Study

Job No.: IV

Title Habitat Destruction Survey

Period Covered: July 1, 1962 through June 30, 1963

Abstract:

Man-made channel alterations were measured on the St. Regis River and Ninemile Creek. A total of 22.38 miles, or 60.3 per cent, of the present 37.1 miles of St. Regis River channel had one or both banks altered. One-hundred an[illegible]ty-one alterations were measured. The total loss of natural stream from channel relocation was 6.39 miles. Fish samples from 4,000 square feet each, of natural and altered stream sections, showed that the natural section had over five times as many game fish as did the altered section.

Activities of man on Ninemile Creek resulted in 7.1 miles of channel with one or both banks altered. This is 29.7 per cent of the stream's present 23.9 miles of length. One-hundred and thirty individual alterations were found and measured within this 7.1 miles. Fish samples from equal areas of stream showed that the natural area had over five times as many fish as did the altered section, which is similar to findings of the St. Regis River.

Recommendations:

Data in this report should be used to help inform the public of the severity and extent of stream habitat destruction in Montana.

Objectives:

The objective of this project was to measure and record the man-made

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alterations to the bed and banks of the St. Regis River (Mineral County) and Ninemile Creek (Missoula County).

Techniques Used:

The St. Regis River is a rapid, clear, mountain stream flowing through a narrow valley which seldom exceeds one-half mile in width. Coniferous forests descend to the stream bank in undisturbed areas. Where flood plains exist, deciduous trees and brush are the predominant types of vegetation. The Milwaukee and Northern Pacific railroads, and U. S. Highway 10, parallel the stream for most of its length.

United States Forest Service aerial photographs, taken in 1958, were used as guide maps for locating alterations, and highway and railroad construction blueprints were used to aid in establishing responsibility of channel alterations on the St. Regis River.

The upper six miles of Ninemile Creek exhibit the characteristics of a mountain stream, with coniferous vegetation and brush along the stream banks. The rest of the stream flows through a relatively broad valley which has been developed for agricultural practices. Stream banks of this portion are vegetated primarily by deciduous trees.

Forest Service aerial photos and maps of the Ninemile Creek area were used as guides in locating alterations and making measurements.

A two-man survey crew inspected the streams on-the-ground to locate alterations, and these alterations were either measured on-the ground, or measurements were taken from an aerial photo if alterations were visible and clear-cut on the photo. River mile measurements were taken from the aerial photographs.

The number of each channel alteration was recorded on the aerial photo at the appropriate location. Data and remarks specific to each alteration were recorded on a field form to aid in correctly categorizing each alteration

All alterations observed were put into one of the following four categories of activity; (1) railroad construction, (2) road or highway construction, (3) urban and industrial development, and (4) agricultural practices. Agricultural activities included those carried out by farmers or ranchers acting independently or on a cost-sharing basis with a government agency.

Four types of man-made channel alteration were defined to include all types of alterations encountered. These were:

(1) Relocated channels. These replace natural stream meanders. Recent work of this type was readily recognized by straight stream channels that lacked the vegetation normally found on the stream banks and the lack of well defined areas of erosion and deposition associated with a meandering stream. Older channel relocations were difficult to distinguish from naturally cut-off meanders. The history of old channel changes was determined by (a) asking local people, (b) consulting railroad and road construction blueprints, and (c) studying aerial photographs and comparing physical characteristics of the stream above, in, and below the area where a man-made change was suspected.

(2) Riprap. This included areas where trees, shrubs, boulders and/or car bodies were placed on the stream bank. Occasionally, these materials were anchored on the bank to hinder erosion. Roadbed fill and bridge riprapping were included in this category.

(3) Channel clearance. Accomplished by removing obstructions from the natural stream channel and filling pools with stream bed material, usually with little alteration of the stream bank.

(4) Diking. Bulldozing out the stream channel and building a dike of the bed material within the channel or on the stream bank.

To obtain fish population data in portions of stream which had been altered versus natural stream habitat areas, 4,000 square feet of stream in each category were electrofished on the St. Regis and Ninemile Creek. Standard block nets were used to delineate areas. A Variable Voltage Pulsator (Pikes Peak Electronic Co., Littleton, Colorado) energized by a 110-volt Master generator, was used as the electrofishing unit. Captured fish were recorded by species, and lengths and weights were taken.

Findings:

St. Regis River

Three of the four general types of channel alteration described were found and measured on the St. Regis River. No specific instance of channel clearance was found, although it is likely that some channel clearance took place in riprapping during highway and/or railroad construction. The three types found and measured were, (1) channel relocations that cut off natural stream meanders, (2) riprapping, and, (3) diking. The numbers and total lengths of each type of alteration are presented in Table 1. In some instances, alterations were encountered on stream sections which had been previously altered. The numbers of these alterations are included in Table 1, but the lengths of these alterations are not. For instance, a case of riprapping on a new channel was counted as an additional alteration, but only the length of the new channel is included for length of stream altered.

The majority in both number and length of alterations was due to highway and railroad bed fill. While roadbeds are not placed for the specific purpose of riprapping, the effect on the stream is identical to riprapping. Generally speaking, because of the narrow valley through which the stream flows, roadbeds constricted the flow of the St. Regis River into narrow, straight passages which, for all practical purposes, ruined these areas

Table 1. DISTANCE AND NUMBER OF MAN-MADE CHANNEL ALTERATIONS RECOGNIZED ON THE ST. REGIS RIVER, MONTANA, 1962.

Type of alteration	Railroad construction		Road construction		Urban and industrial development		Agricultural activities		Total	
	Feet* altered	No. of alterations	Feet* altered	No. of alterations	Feet* altered	No. of alterations	Feet* altered	No. of alterations	Feet and miles altered	No. of alterations
Relocated channel	19,805	17	8,934	6	0	0	0	0	28,739 5.44 Mi.**	23
Riprapping	43,888	34	35,996	49	4,039	4	0	1***	83,923 15.89 mi.	88
Channel clearance	0	0	0	0	0	0	0	0	0	0
Diking	370	3	824	5	4,355	2	0	0	5,549 1.05 mi.	10
Total	64,063 12.13 mi.	54	45,754 8.66 mi.	60	8,394 1.59 mi.	6	0	1	118,211 22.38 mi.	121

*This is the net amount of channel altered. In some instances the same footage was altered more than once.
**This 5.44 miles of relocated channel resulted in the loss of 6.39 miles of natural stream. The stream was reduced in length by .95 miles.
***This 168 foot alteration occurred in an area which had been riprapped previously.

for stream fishing. The resultant increased rate of flow in the altered sections has likely had an effect on the ~~remaining natural sections,~~ through increased velocities and flows during periods of high runoff.

A total of 121 alterations were found and measured on 22.38 miles of the stream's 37.1 miles of existing channel. The unaltered, or natural, portion of the present St. Regis River is presently 14.72 miles.

A total of 33,745 feet of natural stream meanders were cut off by channel relocation and replaced by 28,739 feet of new channel. The total loss of natural channel was then 6.39 miles, which was replaced with 5.44 miles of straightened, artificial channel.

Railroad construction resulted in the greatest amount of all alteration types, totaling 12.13 miles in length. Road construction accounted for 8.66 miles of alteration, and urban and industrial development for 1.59 miles.

Electrofishing equal areas of stream, representative of altered and natural areas, showed that of the sections sampled, the natural area had over five times as many game fish as did the altered section. Numbers of fish captured and average lengths of these fish are recorded in Table 2.

Table 2. NUMBERS AND AVERAGE LENGTHS OF FISH, BY SPECIES, FROM 4,000 SQUARE FEET EACH, OF NATURAL AND ALTERED STREAM BED, ST. REGIS RIVER AND NINEMILE CREEK, MONTANA, 1962.

	Number and leng[illegible]							
St. Regis River Species	Cutthroat trout	Brook trout	Brown trout	White-fish	Dolly Varden	Cottus	Longnose Sucker	White Sucker
Sec. 1 (Natural)	13 (5.4)*	7 (5.9)	2 (13.7)	35 (11.7)	0	18	1	0
Sec. 2 (Altered)	1 (5.4)	3 (6.7)	2 (7.2)	5 (9.3)	0	38	0	1
Ninemile Creek								
Sec. 1 (Natural)	49 (5.2)	16 (5.0)	0	0	3 (4.8)	8	0	0
Sec. 2 (Altered)	6 (4.9)	6 (4.8)	0	0	1 (5.6)	14	0	0

*Average total length in inches.

Ninemile Creek

The major type of alteration encountered on Ninemile Creek was of a nature which did not allow measurements to be included with any of the previously defined types of alteration. This alteration was damage to stream banks by domestic stock. Habitat damage is evidenced by the trampled down condition of banks, with resultant erosion of these banks, and exposure of bare gravel bars. This is actually a secondary effect of man's agricultural practices, but it is felt that the severity and extent of this practice on Ninemile Creek warrants the inclusion of these measurements with other primary types.

Forty-nine instances of bank damage, totaling 2.41 miles, were measured. Including this amount with amounts of defined types of alteration, a total of 130 individual alterations were located on Ninemile Creek. These alterations occurred on 7.14 miles, (or 29.8 per cent), of the stream's present 23.9 miles of length. The number and length of alterations are presented in Table 3.

Table 3. DISTANCE AND NUMBER OF MAN-MADE CHANNEL ALTERATIONS RECOGNIZED ON NINEMILE CREEK, MONTANA, 1962.

Type of alteration	Railroad construction		Road construction		Urban and industrial development		Agricultural activities		Total	
	Feet* altered	No. of alterations	Feet* altered	No. of alterations	Feet* altered	No. of alterations	Feet* altered	No. of alterations	Feet and miles altered	No. of alterations
Channel relocation	0	0	0	0	0	0	3,497	6	3,497 0.66 mi.**	6
Riprapping	379	5	2,886	24	0	0	5,711	24	8,976 1.70 mi.	53
Channel clearance	0	0	0	0	0	0	0	0	0	0
Diking	0	0	0	0	9,989	4	2,551	18	12,540 2.37 mi.	22
Bank alteration*	0	0	0	0	0	0	12,713	49	12,713 2.41 mi.	49
Total	379 0.07 mi.	5	2,886 0.55 mi.	24	9,989 1.89 mi.	4	24,472 4.63 mi.	97	37,726 7.14 mi.	130

*This is not a standard category; see text.
**This 0.66 miles of relocated channel resulted in the loss of 0.88 miles of natural stream.

Diking was the most prevalent type of defined alteration found, totaling 2.37 miles. Diking was primarily due to dredge-mining operations, which had the effect of channel clearance in addition to diking. Amounts of riprapping and channel relocation were 1.70 and 0.66 miles respectively. In the channel relocation category, 0.88 miles of natural stream channel were replaced by 0.66 miles of new and straightened channel. No channel clearance, other than that which occurred in conjunction with dredge-mining and diking was observed.

Sampling of the fish population contained in both natural and altered sections of stream, showed that the number of game fish in the natural section was again five times more than in the altered section. (Table 2).

Prepared by Ralph W. Boland

Approved by George D. Holton

Date November 30, 1962

MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION
HELENA, MONTANA

JOB COMPLETION REPORT
INVESTIGATIONS PROJECT

State of Montana

Project No. F-12-R-9 Name Western Montana Fisheries Study

Job No. III Title Aerator Evaluation

Period Covered June 30, 1962 to June 30, 1963

Abstract:

Browns and Georgetown Lakes were mechanically aerated in an effort to evaluate the effects of aeration on water temperatures and dissolved oxygen concentrations during winter and early spring.

Surface dissolved oxygen concentrations at all stations remained adequate for fish throughout the relatively mild winter of 1962-1963. Surface dissolved oxygen concentrations ranged from 5 to 7 ppm at Browns Lake and from 5 to 10 ppm at Georgetown Lake. No increase in dissolved oxygen concentrations were evident during aerator operations; however, mid-depth and bottom dissolved oxygen concentrations remained highest at stations near the aerators.

Dissolved oxygen concentrations at the control lakes (Upsata and Echo) and at stations in Browns and Georgetown which were isolated from the aerators progressively declined at mid and bottom depths but remained constant at the surface.

Mechanical aeration had no apparent cooling effect on the lakes. Water temperatures recorded at Browns and Georgetown Lakes showed no constant change before or during the period of aeration.

Recommendations:

The Curtis aerators should be operated again during the 1963-64 winter season, and sampling should continue with the following changes:

1. Stations in the control lakes and Station I in Georgetown Lake should be moved to where the depth is similar to the depth of stations near the air lines.

2. Stations II and IV on Georgetown Lake should be moved to at least one-quarter mile from each side of the air line, and Stations V and VI should be moved to one-half mile from each side of the air line.

Objectives:

The objective of this study is to determine the ability of two mechanical aeration systems to maintain adequate winter oxygen concentrations for sustaining fish life in Browns and Georgetown Lakes. These lakes are shallow, productive lakes with a history of periodic winter fish kills.

During the winter of 1961-62, a Hinde Air Aqua system was installed at Browns Lake. The system consisted of three Bell and Gossett compressors, each connected to 500 feet of feeder hose and 1000 feet of air hose. The air lines were set in 12 to 15 feet of water in three, parallel T-formations. This arrangement was recommended by the Hinde Company. The system began operating in November of 1961 and continued through March of 1962. During this period the Hinde aerators never opened water over their entire air lines, and during severe cold spells kept only a few 4- to 5-foot holes ice free.

Throughout the operation, dissolved oxygen samples were taken at five stations on Browns Lake, including one sample station 300 feet from the air line. Dissolved oxygen concentrations just below the ice dropped to less than 3.5 ppm at all stations by February 2, and less than 1.6 ppm by March 29. Mid-depth and bottom dissolved oxygen concentrations ranged between 1.8 and 0.0 ppm during the sampling period. A severe fish kill was discovered shortly after spring breakup.

In January 1962, a Curtis C-80 compressor with 4000 feet of air hose was installed at Georgetown Lake. The unit was able to maintain a strip of open water the entire length of its air line throughout the late winter and early spring. No dissolved oxygen samples were taken; however, the successful operation of this compressor in maintaining open water was coincidental with a spring ice breakup which occurred two weeks earlier than usual.

In view of the mechanical success of the Curtis air compressors in maintaining open water, it was decided to evaluate their ability to maintain an adequate winter dissolved oxygen concentration for fish life.

Techniques Used:

In the fall of 1963, two Curtis C-80 air compressors were installed at opposite sides of Georgetown Lake with their air lines (4000 feet for each compressor) meeting about the center of the lake, (see Figure 1). A third unit was installed at Browns Lake with a 3600-foot airline transecting about three-fourths the width of the lake, (see Figure 2). Each unit delivers 22 cubic feet of air per minute which is distributed through a 3/4 inch, plastic-pipe, air line. Small holes were punched in the plastic pipe at ten-foot intervals with a number 8 sewing needle. The pipe was laid by boat in 400-foot sections and weighted to the bottom by 3-foot lengths of 3/4-inch reinforcing rod, taped to the pipe at 17-foot intervals. The systems were installed in October 1962 and put into operation on March 11, 13, and 15, 1963.

The Hinde Air Aqua system, used at Browns Lake in the winter of 1961 - 1962, was installed at Georgetown Lake over one mile from the Curtis units and was put into operation on March 13, 1963.

Temperatures were recorded with an electric resistance thermometer, and dissolved oxygen determinations were made with a Hach oxygen kit. Oxygen and temperature data were collected at four stations on Browns Lake, six stations at Georgetown Lake and one each on Echo and Upsata Lakes. Data were collected at the surface, mid-depth (midway between the surface and the bottom) and the bottom.

The locations of the stations in relation to the air lines were: Georgetown Lake; Stations II, III, and IV near the Curtis air lines; Stations V and VI near the Hinde air lines; Station I in the outlet bay which is over one mile from the nearest airline and in a narrow bay. Browns Lake; Station II within 300 feet of the air line; Stations I and III in the main lake but approximately one-quarter mile north and south of the air line respectively; Station IV in the inlet bay, which is almost isolated from the main lake by a long point and a shallow weed bed.

Figure 1. Location of airline system and oxygen-temperature stations on Georgetown Lake

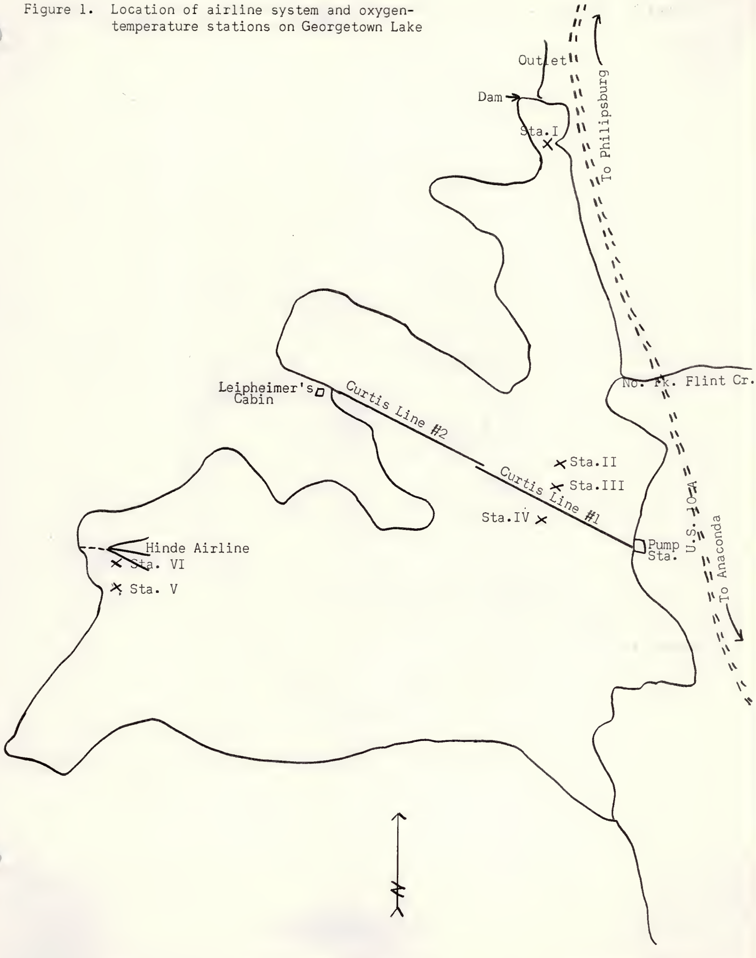

Figure 2. Location of airline system and oxygen-temperature stations on Browns Lake.

The oxygen and temperature series began February 5 at Browns Lake and February 15 at Georgetown Lake and continued through early spring. Sampling at the control lakes began February 10 at Echo Lake (control for Georgetown Lake) and February 12 at Upsata Lake (control for Browns Lake) and continued through March. Sampling was done at approximately two-week intervals.

Findings:

During the mild winter of 1962-63 it is likely that neither Browns nor Georgetown Lakes would have had a severe winterkill even had they not been aerated. Browns Lake had a maximum ice cover of 18 inches with snow depth ranging from 2 to 14 inches during the period of sampling. Georgetown Lake's maximum ice cover was 26 inches and its snow cover varied from 2 to 24 inches during the same period. Intermittent periods of warm and cold weather did not allow either lake to stand for long periods with heavy snow cover.

The Browns Lake aeration system began operating March 13 and continued until ice breakup on April 14. A week after aeration, a channel of open water approximately 1600 feet in length was visible. By April 1, the channel was open over the entire 3600-foot air line. Prior to ice breakup the channel had widened to an estimated 300 feet.

The Browns Lake oxygen series began February 13 and continued through March 26, (see Table 1). Surface dissolved oxygen concentrations at four stations varied between 5 and 7 ppm during the entire sampling period. Mid-depth dissolved oxygen readings, with the exception of Station IV, ranged between 4 and 6 ppm. The dissolved oxygen concentration at the lake bottom varied between 0 and 6 ppm.

No consistent increases in dissolved oxygen concentrations were noted at any one station prior to, or during, the operation of the air system. Surface dissolved oxygen readings of 6 ppm at Station II, 300 feet from the air line, remained constant during the course of the sampling period. Slight fluctuations in dissolved oxygen concentrations at the other stations were probably due to variations in photosynthetic activity as a result of various depths of snow cover on the ice from time to time.

Oxygen determination made at Upsata Lake (control for Browns Lake) between February 12 and March 21 ranged from 8 to 9 ppm (Table 2). A gradual decrease in the dissolved oxygen content at mid and bottom depths occurred throughout the sampling period.

One Curtis aerator at Georgetown Lake was put into operation March 11, the other on March 13, and both continued operating through May 15. By March 25 the open water had appeared over the 8000 feet of air line. The open channel averaged 150 feet in width on May 1. Ice breakup occurred on May 17.

The Hinde Air Aqua system was started on March 13. Small channels of open water were first observed over the three air lines on April 3. By May 1, the three small channels had formed one large channel approximately 200 feet wide and 1000 feet long. Surface dissolved oxygen readings recorded at Stations V and VI, 300 and 600 feet from the air line, remained at 10 ppm before and during the functioning of the air system. Although this system was successful in creating some open water, it could maintain an open strip over the full length of its airline only during mild weather.

The surface dissolved oxygen readings recorded at Echo Lake (control for Georgetown Lake) remained between 9 and 10 ppm from February 10 to April 23 (Table 4). Mid-depth samples progressively decreased from 9 to 2 ppm and bottom samples declined from 3 to 0 ppm.

Table 1. BROWNS LAKE WINTER OXYGEN (ppm) DATA 1963

	Feb. 13	Feb. 21	Mar. 4	Mar. 11*	Mar. 18	Mar. 26
Surface						
Sta. I	6	6	6	6	7	7
Sta. II	6	6	6	6	6	6
Sta. III	6	6	6	7	6	7
Sta. IV	5	6	-	5	5	5
Mid-Depth						
Sta. I (8 ft.)	6	6	6	4	6	4
Sta. II (10 ft.)	5	6	4	5	4	4
Sta. III (8 ft.)	6	5	6	6	5	5
Sta. IV (8 ft.)	3	1	-	1	1	2
Bottom						
Sta. I (15 ft.)	1	3	2	1	1	4
Sta. II (19 ft.)	1	1	4	2	2	4
Sta. III (13 ft.)	6	5	4	4	4	5
Sta. IV (15 ft.)	1	1	-	0	1	1

* Air System Began Operation

Table 2. UPSATA LAKE WINTER OXYGEN (ppm) DATA 1963

	Feb. 12	Feb. 26	Mar. 21
Surface	8	9	9
Mid-Depth (14 ft.)	5	4	2
Bottom (28 ft.)	2	1	1

Table 3. GEORGETOWN LAKE WINTER OXYGEN (ppm) DATA 1963

	Feb. 5	Feb. 18	Mar. 5	Mar. 13*	Mar. 19	Mar. 25	Apr. 16	Apr. 23
Surface								
Sta. I	8	10	10	10	7	6	6	5
Sta. II	9	10	10	--	-	-	-	-
Sta. III	10	10	10	--	-	9	6	-
Sta. IV	9	10	10	10	-	9	7	-
Sta. V	10	10	10	10	10	10	-	10
Sta. VI	10	10	10	10	10	10	-	10
Mid-Depth								
Sta. I (15 ft.)	7	2	1	1	1	0	2	1
Sta. II (9 ft.)	-	-	-	-	-	-	-	-
Sta. III (7 ft.)	-	-	-	-	-	9	6	-
Sta. IV (7 ft.)				7	-	9	6	-
Sta. V (7 ft.)			10	10	7	9	-	8**
Sta. VI (7 ft.)			10	10	7	10	-	6**
Bottom								
Sta. I (29 ft.)	2	0	0	0	0	0	0	0
Sta. II (17 ft.)	5	6	6	-	-	-	-	-
Sta. III (13 ft.)	6	6	6	-	-	5	5	-
Sta. IV (13 ft.)	5	5	6	4	-	6	4	-
Sta. V (13 ft.)	6	6	3	2	4	5	-	3**
Sta. VI (13 ft.)	7	3	4	4	5	6	-	2**

* Aerators Began Operation March 11 and 13
** Inaccessible, Samples Taken Within 300 Feet of Original Location

Table 4. ECHO LAKE WINTER OXYGEN (ppm) DATA 1963

	Feb. 10	Feb. 18	Mar. 9	Mar. 19	Apr. 16	Apr. 23
Surface	10	10	10	10	10	9
Mid-Depth (12 ft.)	9	9	6	4	4	2
Bottom (24 ft.)	3	3	2	1	3	0

Dissolved oxygen concentrations remained relatively high at Georgetown Lake throughout late winter and early spring (Table 3). Surface dissolved oxygen samples taken at six stations ranged between 5 and 10 ppm from February 5 through April 23. With the exception of Station I, mid-depth samples varied between 6 and 10 ppm and bottom oxygen concentrations ranged from 2 to 7 ppm. A gradual decline in surface dissolved oxygen readings occurred after March 13 at Stations I, III and IV but no consistent changes in mid-depth and bottom dissolved oxygen were observed.

Even though there was no constant increase in dissolved oxygen concentrations at any station on Georgetown and Browns Lakes, when the stations are grouped by their proximity to the air lines, it is apparent that the final, mid-depth and bottom level dissolved oxygen concentrations were highest in those portions of the lake that could have been affected by the air lines. Table 5 shows the range of final, mid-depth and bottom level dissolved oxygen concentrations for stations from all lakes under study, grouped into four categories.

TABLE 5. Final dissolved oxygen concentrations by four types of stations, all study lakes.

Type station	Range of final, mid-depth and bottom-level dissolved oxygen concentrations
Stations in vicinity of Curtis Aerators Georgetown II, III, IV. Browns I, II, III.	4-7 ppm
Stations in vicinity of Hinde Aerators Georgetown V, VI.	2-8 ppm
Stations in aerated lakes but isolated from air lines Georgetown I Browns IV	0-2 ppm
Stations in control lakes	0-2 ppm

Thus, even though it was not possible to determine the ability of the aerators to maintain adequate dissolved oxygen concentrations during a severe winter, it appears that they did maintain dissolved oxygen concentrations at an adequate level for fish life at mid-depth and bottom levels up to a distance of one-quarter mile from the air lines. Although this was during a mild winter, similar stations in unaffected areas of the aerated lakes and in control lakes did not have a high enough dissolved oxygen concentration to sustain fish life at the mid-depth and bottom levels. The mid-depth and bottom dissolved oxygen concentrations at the two isolated stations in the aerated lakes were either lower at the start of sampling, or dropped sooner than at the stations in the control lakes. This is to be expected because Browns and Georgetown Lakes are more productive than Echo and Upsata Lakes and have a history of periodic winterkills.

The temperature series for the four lakes are shown in Tables 6, 7, 8 and 9. All readings are in Fahrenheit. No consistent drop in temperature is evident in any of the lakes.

Table 6. BROWNS LAKE WINTER TEMPERATURES(°F) 1963

	Feb. 13	Feb. 21	Mar. 4	Mar. 11*	Mar. 18	Mar. 26
Surface						
Sta. I	--	35	34	34	34	36
Sta. II	34	32	34	35	35	37
Sta. III	32	34	34	35	34	36
Sta. IV	--	34	--	35	34	35
Average	33	33	34	35	34	36
Mid-Depth						
Sta. I (8 ft.)	--	36	37	37	37	38
Sta. II (10 ft.)	35	36	37	37	36	38
Sta. III (8 ft.)	35	36	37	37	37	38
Sta. IV (8 ft.)	--	37	--	38	39	38
Average	35	36	37	37	37	38
Bottom						
Sta. I (15 ft.)	--	38	38	39	39	38
Sta. II (19 ft.)	35	38	38	38	37	38
Sta. III (13 ft.)	36	37	38	38	38	38
Sta. IV (15 ft.)	--	39	--	39	40	40
Average	36	38	38	39	39	39

* Air System Began Operation

Table 7. UPSATA LAKE WINTER TEMPERATURES (°F) 1963

	Feb. 12	Feb. 26	Mar. 21
Surface	32	34	35
Mid-Depth (14 ft.)	38	38	36
Bottom (28 ft.)	38	39	37

Table 8. GEORGETOWN LAKE WINTER TEMPERATURES (°F) 1963

	Feb. 5	Feb. 18	Mar. 5	Mar. 13	Mar. 19	Mar. 25	Apr. 16	Apr. 23
Surface								
Sta. I	33	34	34	33	34	33	34	34
Sta. II	34	34	34	--	--	--	--	--
Sta. III	33	34	34	--	--	34	35	--
Sta. IV	34	34	34	33	--	35	36	--
Sta. V	33	34	34	34	34	34	--	34*
Sta. VI	33	34	34	34	34	33	--	34*
Average	33	34	34	34	34	34	35	34
Mid-Depth								
Sta. I (15 ft.)	--	37	37	37	38	37	38	38
Sta. II (9 ft.)	--	--	--	--	--	--	--	--
Sta. III (7 ft.)	--	--	--	--	--	34	36	--
Sta. IV (7 ft.)	--	--	--	36	--	35	36	--
Sta. V (7 ft.)	--	--	36	38	37	37	--	37*
Sta. VI (7 ft.)	--	--	37	37	37	37	--	37*
Average	--	37	37	37	37	36	37	37
Bottom								
Sta. I (29 ft.)	39	40	38	39	40	40	40	40
Sta. II(17 ft.)	39	38	37	--	--	--	--	--
Sta. III(13 ft.)	39	37	36	--	--	37	37	--
Sta. IV (13 ft.)	38	38	37	37	--	37	37	--
Sta. V (13 ft.)	39	38	37	38	39	39	--	39*
Sta. VI (13 ft.)	37	38	38	39	39	39	--	40*
Average	38	38	37	38	39	38	38	40

* Aerators Began Operation March 11 and 13.

Table 9. ECHO LAKE WINTER TEMPERATURES (°F) 1963

	Feb. 10	Feb. 18	Mar. 9	Mar. 19	Apr. 16	Apr. 23
Surface	34	33	34	33	34	32
Mid-Depth	38	38	38	38	39	39
Bottom	38	40	39	39	40	39

Prior to aeration on March 11, the surface temperatures at the four Browns Lake stations averaged 35° as compared to 36° when the final temperature series was recorded March 26.. Mid-depth temperature before aeration 37° as compared to 38° recorded at the termination of the series. The average bottom temperature, 39° remained constant from March 11 through March 26.

The water temperature series for Upsata Lake is presented in Table 6. Water temperatures taken during the sampling period rose from 32° to 35° at the surface, decreased from 38° to 36° at mid-depth, and decreased from 38° to 37° on the bottom.

The average surface temperature at Georgetown Lake just prior to aeration on March 5 was 34°, Table 7. The surface temperature was still 34° on April 23, after aerators had been in operation for a period of 6 weeks. During the same period, average mid-depth temperatures ranged between 36° and 37° and bottom temperatures rose from an average of 37° to 40°.

Echo Lake water temperatures showed no appreciable change during the sampling periods. Surface temperatures ranged between 32° and 34°, mid-depth temperatures varied from 38° to 39° and bottom temperatures varied between 38° and 40°, Table 8.

Prepared by Robert J. Domrose

Date February 25, 1964

Approved by George D Holton

MONTANA FISH AND GAME DEPARTMENT
Fisheries Division
Helena, Montana

JOB COMPLETION REPORT
INVESTIGATIONS PROJECTS

State of Montana

Project No. F-12-R-9 Name: Western Montana Fishery Study

Job No. II-A Title: Georgetown Lake Creel Census

Period covered: December 1, 1962 to March 30, 1963

Abstract:

A winter creel census was conducted at Georgetown Lake during the 1962-1963 special 27 day winter ice fishing season. An estimated 11,774 fisherman harvested 34,969 game fish for 46,432 hours of fishing effort. The average hourly catch rate was 0.75 fish and the average catch per angler was 2.97 fish. Hatchery rainbow and cutthroat, exclusive of the 1961 plant, comprised 55.2 percent of the harvest. Local anglers made up 96.4 percent of the angling pressure.

Approximately one-third of the annual harvest and one-fourth of the annual fishing pressure occurs during the special ice fishing season. Winter anglers have been more successful than the summer anglers.

Recommendations:

Continue the winter census another year to determine the effect of fishing pressure and harvest with a more liberal season. Proposals were made to extend fishing privileges to include weekdays as well as weekends during the 1963-1964 winter ice fishing season. The number of fishing days will be increased from 27 to 71 days.

Objectives:

The objective of this project is to obtain necessary data for the determination of harvest and pressure estimates during the special ice fishing season on Georgetown Lake. In addition, it is desired to evaluate the contribution of hatchery planted trout to the Georgetown Lake fisheries.

Techniques used:

The 1962-1963 winter ice fishing season opened December 12, 1962 and continued through February 24, 1963. During this period, fishing was permitted during regular fishing hours (0500-2200 hours) on Saturdays, Sundays, and legal holidays. A creel census technician was on duty each day of the 27 day season.

Techniques cont.

Census days were designated as either morning or afternoon census periods and were of a 9-hour duration. The selection of census periods was chosen in a systematic random manner following an initial random selection of a time period. The morning census period began at 0600 hours and ended at 1500 hours. The evening census period began at 1200 hours and continued until 2100 hours. The census scheduling is shown in Appendix A.

Completed trip information was obtained from each fishing party. This information included: the number of anglers in the party, residency of the angler, length of the fishing trip, species caught, and the total number of fish caught. Clip marks of hatchery fish were recorded to provide information on the success of hatchery plants.

In addition to completed trip information, the census technician was instructed to obtain counts of angler cars during daylight hours and light counts on the ice during the hours of darkness. Light and car counts were made at 3-hour intervals from the beginning to the close of each census day. Consequently, four counts were made during the census day.

The number of anglers per light was determined by a subsample of the pre-dawn and late evening anglers. The number of anglers per car was established by dividing the total number of party contacts by the total number of anglers, since one census form was used for each car interview.

With one exception, the mechanics of the census were similar to census conducted on Georgetown Lake during the winter ice fishing season of 1960-1961. Formerly, the lake was divided into three areas to obtain catch and pressure data from each portion of the lake. Each area of the lake was sampled for a 3-hour period during the census day. This method of sampling was discontinued because certain areas of the lake had greater fishing use than others. Much valuable contact information was lost when sampling areas of light fishing pressure.

Contact information was taken from all areas of the lake as fishing parties departed from the ice. As snow conditions worsened, anglers were unable to drive onto the ice and fishermen concentrated their efforts to the more accessible areas along the highway. Efforts were made to obtain a larger number of contacts by sampling the areas with the greatest fishing pressure.

Prior to 1960, Georgetown Lake was stocked annually with 300,000 fingerling trout from the Anaconda Fish Hatchery. During the years 1958 through 1960, 150,000 each of cutthroat and rainbow trout were stocked, a third of which were distinctively marked. Previous investigation from a summer census conducted in 1961 has shown a greater return to the creel of rainbow than cutthroat trout. Consequently, from this evaluation, cutthroat trout were removed from the planting program and their numbers were replaced by rainbow trout on the 1962 and 1963 stocking programs. In 1961, 410,000 unmarked fish were planted in the lake. Of these 89,000 were 7 to 9 inch rainbow trout. In 1962, 225,927 rainbow were stocked of which 125,927 were of catchable size. Approximately one-third of the catchable fingerling rainbow were marked by removal of the right premaxilary bone.

The sehedule for the operation of the census was formulated under the direction of the department statistician. Census data were compiled monthly and reported in monthly narrative summaries. Census contact forms were sent to the department's I. B. M. service and information was recorded on standard I. B. M. punch cards.

Findings:

The following species of game fish contributed to the Georgetown Lake fishery during the winter of 1962-1963: Rainbow trout (Rb), Salmo gardneri; cutthroat trout (Ct), Salmo clarki; Kokanee (KOK), Oncorhyncus nerka; brook trout (Eb), Salvelinus fontinalis; artic grayling (Gr), Thymallus arcticus; and brown trout (LL), Salmo trutta.

Information regarding the species composition of the catch by percent, and numbers recorded by the census technician, are presented in Table 1.

Table 1. Species composition by percent of catch recorded by census technician, Georgetown Lake, 1962-1963 winter census (numbers of fish are in parenthesis).

Rb*	Rb**	Ct	Ct***	Kok.	Eb.	Gr.	LL
54.5	17.3	14.4	1.1	6.7	6.1	trace	trace
(1801)	(573)	(477)	(41)	(221)	(201)	(1)	(1)

*Unmarked hatchery Rb and Ct (includes wild fish and the 1961 plant which was not marked, and the unmarked two-thirds of all other plants)
** Marked hatchery rainbow (one-third of plant marked)
*** Marked hatchery cutthroat (one-third of plant marked)

Rainbow and cutthroat trout are the two most important species which contribute to the Georgetown Lake fishing. These species comprise 86.9 percent of the harvest.

As was stated previously, one-third of the 1962 hatchery plants in Georgetown Lake were marked. The percent of harvest of both rainbow and cutthroat hatchery trout, exclusive of the 1961 plant, was 55.2 percent. The composition of wild and unmarked rainbow stocked in 1961, was 19.8 percent. Unmarked and wild cutthroat made up 12.2 percent of the catch.

During the 1962-1963 winter ice fishing season, the census technician interviewed 1114 fishermen. These anglers were successful in catching 3314 fish for 4397 hours of fishing effort. The catch rate per angler was 2.97 fish and the average hourly catch rate was 0.75 fish. The average length of angler trip was 3.97 hours.

For purposes of data analysis, the season was stratified into two segments, opening day (strata 1) and weekends and holidays, (strata 2). These strata are treated independently.

The data analysis is dependent upon the relationship between angler and light counts, angler and car counts, and the expansion of contact data for the period of day not censused.

To calculate the fishing pressure in terms of total number of anglers, the average number of fishermen per hour is multiplied by the total possible fishing hours for each strata to obtain the total hourly effort expended. This value is then divided by the average length of trip to determine the total number of fishermen. The total number of anglers during the season is the combined angler-use from strata I and II. Harvest estimates can then be derived from the catch-per-angler-hour value for each strata.

The procedure for calculating the total number of anglers is as follows:

(1) Multiply the average number of anglers per light by the total light counts to determine total light-angler counts.

(2) Multiply the average number of anglers per car by the number of car counts to determine car-angler counts.

(3) Add the total car and light counts.

(4) Divide the car and light counts by the number of hourly counts to establish the average number of anglers per hour.

(5) Multiply the number of hours in the fishing day by the average number of angler hours per day.

(6) Divide the total number of angler hours by the average length of fishing trip to determine the total number of anglers.

(7) Add the total number of anglers from strata I and strata II.

Harvest estimates were determined by multiplying the total number of fisherman by the hourly catch rate.

A general description of data analysis is described in Appendix B. The values obtained for the computation of data are shown in Appendix C. Total estimates of fishermen, hours fished, harvest and fiducal limits at the 95 percent level are presented in Table 2.

Table 2. Estimates of fishermen, hours fished, harvest anf fiducal limits at the 95 percent level

	Lower limit	Point estimate	Upper limit
Fishermen			
Opening day	1,235	1,366	1,497
Weekends and holidays	9,808	10,408	11,008
Total fishermen	11,043	11,774	12,505
Hours fished			
Opening day	4,802	5,313	6,443
Weekends and holidays	37,165	41,119	45,073
Total hours fished	41,967	46,432	51,516
Harvest			
Opening day	3,560	3,719	3,878
Weekends and holidays	30,016	31,250	32,072
Total Harvest	33,576	34,969	35,950

Approximately 12 percent of the seasonal fishing pressure and harvest was accounted for on opening day. The number of angler trips on opening day was 1366 as compared to an average of 400 per day on weekends and holidays for the remainder of the season.

In comparison to the winter census conducted on Georgetown Lake during the 1960-1961 winter season, the number of angler trips, harvest, and total fishing hours declined appreciably over the 1962-1963 winter season. The number of angler trips declined from 15,324 to 11,774 or in terms of trips per acre dropped from 5.1 to 3.9. The total hourly effort decreased from 68,868 to 46,452 hours. Total harvest showed a decrease of approximately 15,000 fish, dropping from 49,175 to 34,967. The hourly catch rate increased slightly from 0.71 during the 1960-1961 season to 0.75 for the 1962-1963 season.

Additional creel information was obtained by a summer creel census during the summer of 1962. Total pressure and harvest data for the combined winter and summer census are shown in Table 3.

Table 3. Georgetown Lake pressure and harvest estimates during the summer of 1962 and winter of 1962-1963

	Fishermen	Hours fished	Harvest	Catch per hour	Anglers per acre
Summer census (May 20-Oct. 31)	44,500	174,629	82,970	0.48	14.8
Winter census (Dec 12-Feb 24)	11,774	46,432	34,969	0.75	3.9
Combined total	56,274	221,061	117,939	0.53	18.7

Approximately one-fifth of the total angling pressure and one-third of the harvest occurred during winter ice fishing season. The winter hourly catch rate increased by 0.27 fish per hour as compared to the summer hourly catch rate.

The estimated weight of the total catch was calculated by multiplying the total number of each species by the average weight of each species. Individual weights were collected from 605 fish. The estimated weights and numbers of four species of game fish are presented in Table 4.

Table 4. Average weight, estimated total numbers and estimated total weight of fish checked through checking station. Total number of fish weighed in parenthesis.

Species	Average weight (lbs)	Estimated number	Estimated weight (lbs)
Rb (498)	0.77	25,038	19,279
Ct (55)	1.15	5,455	6,273
Eb (47)	0.79	2,133	1,685
Kok (5)	1.24	2,343	2,905
		Total weight	30,142

By weight, rainbow trout made up approximately 60 percent of the harvest. The total harvest of game fish was 30,142 pounds.

A check on the residency of anglers shows that the winter-ice fishing is primarily of local significance. Approximately 97% of the anglers reside within a 40-mile radius of the lake. Most of the local pressure comes from the urban areas of Anaconda and Butte. About 3% of the angling pressure resides at a distance of greater than 40 miles and about 1% of the anglers are from out of state.

Prepared by ROBERT J. DOMROSE Approved by George D Holton

Date March 23, 1965

Appendix A.

Georgetown Lake winter creel census schedule-1962-1963

December 9, 15, 16*, 22*, 23, 25*, 29, 30*

January 1, 5*, 6, 12*, 13, 19*, 21, 26*, 27

February 2*, 3, 9*, 10, 12*, 16, 17*, 22, 23*, 24

* indicates afternoon census day.

Appendix B.

Summary of Georgetown Lake data analysis

Strata I (opening day)

	No. of counts at 3-hour intervals	Total lights or cars counted	Ave. no. of anglers per car or light	Estimated fishermen
Light counts	1	140	1.46	204
Car counts	3	508	2.06	1046
Total	4			1250

$\frac{1250}{4}$ = $\frac{\text{(Estimated fishermen)}}{\text{(No. of counts at 3-hour intervals)}}$ = 312.5 (ave. no. of anglers per hourly count)

312.5 x 17 (total fishing hours in strata I) = 5312.5

$\frac{5312.5}{3.89}$ = $\frac{\text{(total angler-hours in strata I)}}{\text{(ave. length of trip in hours)}}$ = 1366 (total fishermen)

5312.5 x 0.70 (catch per angler-hour) = 3719 (total harvest)

Strata II (weekends and holidays)

	No. of counts at 3-hour intervals	Total lights or cars counted	Ave. no. of anglers per car or light	Estimated fishermen
Light counts	31	1141	1.59	1814
Car counts	69	3653	2.05	7489
Total	100			9303

$\frac{9303}{100}$ = $\frac{\text{(Estimated fishermen)}}{\text{(No. of counts at 3-hour intervals)}}$ = 93.03 (ave. no. of anglers per hourly-count)

93.03 x 442 (total angler-hours in strata II) = 41,119

$\frac{41,119}{3.95}$ = $\frac{\text{(total angler-hours in strata II)}}{\text{(ave. length of trip)}}$ = 10,408 (total fishermen)

41,119 x 0.76 (catch per angler-hour) = 31,250 (total harvest)

Appendix C.

Values obtained for use in computation of data for Strata I and II.

	Strata I (opening day)	Strata II (weekends an holidays)
Number of fishing days in season	1	26
Number of fishing hours in season	17	442
Anglers per light	1.46	1.59
Anglers per car	2.06	2.05
Average number of anglers per hourly count	312.5	93.0
Total fishing pressure in hours	5,313	41,119
Total number of anglers	1,366	10,408
Total harvest	3,719	31,250
Average length of trip (hours)	3.89	3.95
Average catch per angler	2.68	3.00
Average catch per angler-hour	0.70	0.76

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MONTANA FISH AND GAME DEPARTMENT
Helena, Montana

FISHERIES DIVISION
JOB COMPLETION REPORT
INVESTIGATIONS PROJECT

#9

State of Montana

Project No. F-12-R-9 | Name Western Montana Fishery Study

Job No. II | Title Georgetown Lake Creel Census

Period Covered: May 1, 1962 - April 30, 1963

Abstract:

A partial creel census was conducted on Georgetown Lake during the summer fishing season of 1962. This census was a continuation of the annual investigation of the Georgetown Lake fishery. The season was opened approximately one month earlier than usual, which resulted in decreasing the opening day catch and pressure by 79 and 77 percent, respectively, from 1961 estimates. Total harvest and pressure for the entire season were increased by 65 and 32 percent, respectively. The increase in harvest was due to an unusually large plant of catchable-sized rainbow trout, in addition to the longer season.

The total estimated pressure on Georgetown Lake in 1962 was 174,500 hours, and total harvest was 83,000 fish. The total estimated number of angler trips was 44,500 trips. The catch rate for all anglers on opening day was 0.36 fish per angler hour, and for the remainder of the season was 0.48 fish per hour.

Recommendations:

1. It is recommended that the lake continue to be planted with rainbow trout only.

2. Census schedules and data analysis methods should remain unchanged as much as possible in future censuses.

3. Closer screening and supervision of temporary census personnel is necessary to insure the reliability of information collected.

Objectives:

The objective of the Georgetown Lake summer creel census was to obtain data for reliable estimates of total fishing pressure and game fish harvest. These data will be used in formulating future fishery management practices for this popular recreational water.

Techniques Used:

To obtain a reliable cross-section of creel census data from this 3,000 acre lake, a sampling program based on that described by Neuhold and Lu, 1957, was employed. The same procedures for creel census and analysis of data, as are described in the Georgetown Lake Study report for the 1961 season were followed as closely as possible.

Briefly, this type of census employs both through-angler contacts and instantaneous counts of shore anglers and boats. In addition, counts were made independently of boat and shore angler counts to determine the average number of anglers per boat.

The fishing season was stratified into two-week periods, omitting opening day, which was treated separately. Five instantaneous counts were made on opening day, and census personnel obtained through-angler contact data when not engaged in making counts. Seven days from each two-week period for the remainder of the season were selected randomly for census, with the restriction that each day of the week was included once in a 14-day period. Creel census was conducted as scheduled, with the exception of two days which were inadvertently omitted. Two counts were made each day, at systematically selected times from four strata within each day. The census taker obtained contact data when not involved in making scheduled counts.

The Georgetown Lake summer fishing season was opened on May 20 and closed on October 31, 1962. Prior to 1962, the lake had a special late opening date, usually in the last week of June. The late opening date was employed to protect late spawning cutthroat trout, but since it was determined in 1961 that approximately 87 percent of trout harvested were fish planted as fingerlings, and that rainbow trout provided a better return to the creel than did cutthroat trout, emphasis was placed on management with rainbow trout rather than with cutthroat trout.

The season in 1962 lasted for 165 days. Creel census data were obtained on opening day and 79 other days throughout the season. Information obtained from anglers included the following:

1. Fishing license number
2. Residence
3. Hours fished
4. Total fish caught
5. Species and fin clip of fish caught
6. Boat or shore fisherman

After compiling census data, a question arose concerning the accuracy of species identification by one temporary census technician. Of 536 rainbow and cutthroat trout checked by this individual, 10.8 percent were classified as cutthroat trout. Two other census clerks classified 33.3 percent of these species as cutthroat trout. There is no way to accurately determine if errors in identification were made, but the question does exist.

Findings:

The following species of game fish contributed to the Georgetown Lake fishery:

Common name	Abbreviation	Scientific name
Cutthroat trout	Ct	*Salmo clarki* Richardson
Rainbow trout	Rb	*Salmo gairdneri* Richardson
Brook trout	Eb	*Salvelinus fontinalis* (Mitchill)
Arctic grayling	Gr	*Thymallus arcticus* (Pallas)
Kokanee	KOK	*Onchorhynchus nerka* (Walbaum)

Census technicians recorded the species of 1,854 fish caught by Georgetown Lake anglers. Rainbow trout composed 60.5 percent of these fish (Table 1). In 1961, 410,000 fish were planted in the lake. Of these, 89,000 were 7- to 9-inch rainbow trout, and the remainder were fingerling cutthroat and rainbow trout. None of the fish were marked, as plants from 1958 through 1960 had been. In 1962 225,927 rainbow were planted, of which 125,927 were catchable size. Of these catchables, 33,055 were marked by the removal of the right premaxillary bone. Thirty-four thousand of the 1961 fingerling plant were marked with the same clip.

Table 1. SPECIES COMPOSITION OF RECORDED CATCH, GEORGETOWN LAKE, 1962.

	Ct*	Ct**	Ct***	Ct****	Rb*	Rb**	Rb***	Rb****	Eb	Gr	KOK	Total
No.	343	17	30	56	1122	33	68	72	88	1	24	1854
%	18.5	0.9	1.6	3.0	60.5	1.8	3.7	3.9	4.7	0.1	1.3	100.0

* No fin clip **1958 fin clip ***1959 fin clip ****1960 fin clip

The analytical procedure for obtaining total harvest and pressure estimates were presented in detail in the 1961 Georgetown Lake Creel Census report (Boland and Leik,1962). This detail will not be repeated in this report, but values obtained from the various calculations are included in Appendix A. Symbols used in calculations are identical to those used in 1961, and are included to facilitate comparison of values.

Estimates of harvest, pressure, and success rates for each major strata were totaled to obtain season total estimates (Table 2).

Table 2. SHORE AND BOAT FISHING PRESSURE, SUCCESS RATE, AND HARVEST, GEORGETOWN LAKE, 1962.

		Confidence Interval ($t_{.95}$)		
		Lower Limit	Point Estimate	Upper Limit
Opening Day				
	Shore fishing pressure	1,482	2,972	4,462
	Boat fishing pressure	1,862	2,392	2,922
	Combined shore and boat fishing pressure	4,186	5,364	6,542
	Combined shore and boat rate of success	.2998	.3559	.4120
	Combined shore and boat total harvest	1,481	1,909	2,337
May 21 - Oct. 31	Shore fishing pressure	73,882	84,588	95,294
	Boat fishing pressure	76,890	84,677	92,464
	Combined shore and boat pressure	156,260	169,265	182,270
	Combined shore and boat rate of success	.3827	.4789	.5751
	Combined shore and boat total harvest	74,834	81,061	87,288
Season Totals				
	Hours pressure	160,446	174,629	188,812
	Harvest	76,315	82,970	89,625

The average length of trips on opening day was 5.49 hours. The total pressure on opening day was 5,364 hours, hence, an estimated 977 angler trips were made to Georgetown Lake on this day. The average length of trips for the remainder of the season was 3.89 hours, and the total pressure was 169,265 hours. The estimated number of fisherman trips for the remainder of the season is then 43,512. The total number of angler trips was 44,489, an increase of over 14,000 angler trips from 1961.

It is of interest to note the effects of lengthening the fishing season by the early opening date. The point estimate of the opening day rate of success is virtually identical with the 1961 rate for the same period. By opening the Georgetown Lake season coincident with the general season opening date, pressure was reduced by 77 percent. The harvest on the opening day was reduced by 79 percent.

During the remainder of the season, the point estimate of pressure increased by 55 percent and the harvest was increased by 97 percent. For the total season, there was an increase in pressure of 32 percent, and an increase in harvest of 65 percent. It is likely that the increase in harvest was primarily due to the larger number of catchable-sized rainbow planted that year in addition to the lengthened season.

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Prepared by Ralph W. Boland

Approved by George D. Holton

Date April 13, 1964

Appendix A

SYMBOL DEFINITIONS* AND VALUES OBTAINED FOR PERIOD FROM MAY 21 TO OCTOBER 31, AND OPENING DAY, GEORGETOWN LAKE, 1962

		May 21 - Oct. 31	Opening Day
N	= Number of counts	157	5
P_s	= Shore fishing pressure in hours	84,588	2,972
$\bar{X}_s$	= Average number of shore fishermen per count	30.34	174.8
H	= Possible fishing hours in period	2,788	17
S_s^2	= Variance of shore angler counts	607	4,983
$S_{\bar{x}s}$	= Standard error of mean shore anglers per count	1.96	31.57
P_b	= Boat fishing pressure in hours	84,677	2,392
$\bar{X}_b$	= Mean number of boats per count	13.38	62.0
$\bar{X}_r$	= Mean number of anglers per boat	2.28	2.27
S_b^2	= Variance of boats per count	230.8	1,260
$S_{\bar{x}b}$	= Standard error of mean number of boats per count	1.21	15.87
S_r^2	= Variance of anglers per boat	38.23	.57
$S_{\bar{x}r}$	= Standard error of the mean number of anglers per boat	.6	.928
$S_{\bar{x}br}$	= Combined standard error for boats per count and anglers per boat	1.35	15.90
T.P.	= Combined shore and boat pressure in hours	169,265	5,364
$S_{\bar{x}T.P.}$	= Standard error combined shore and boat pressure	2.38	35.35
R_b	= Rate of success for boat anglers, expressed as fish per hour	.6533	.5385
F_b	= Total fish caught by boat anglers contacted	959	42
H_b	= Total hours fished by boat anglers contacted	1,468	78
N_b	= Number boat anglers contacted	433	19
$\bar{X}_{bh}$	= Mean number of hours fished by boat anglers	3.3903	4.1053

* Identical to those used in 1961 report.

Appendix A (Continued)

S_{bh}^2	= Variance of hours fished by boat anglers	3.2384	.6666
$S_{\bar{x}bh}$	= Standard error for hours fished by boat anglers	.0861	.187
$\bar{X}_{bf}$	= Mean number of fish caught by boat anglers	2.2148	2.2105
S_{bf}^2	= Variance of fish caught by boat anglers	4.6412	2.3889
$S_{\bar{x}bf}$	= Standard error fish caught by boat anglers	.1034	.3546
$S_{\bar{x}bhbf}$	= Combined standard error of hours fished and fish caught by boat anglers	.0027	.0278
R_s	= Rate of success for shore fishermen, expressed as fish per hour	.3043	.2089
F_s	= Total fish caught by shore anglers contacted	807	33
H_s	= Total hours fished by shore anglers contacted	2,652	158
N_s	= Number of shore anglers contacted	625	24
$\bar{X}_{sh}$	= Mean number of hours fished by shore anglers	4.2432	6.5833
$\bar{X}_{sf}$	= Mean number of fish caught by shore anglers	1.2912	1.3750
S_{sh}^2	= Variance of hours fished by shore anglers	5.2516	4.6956
$S_{\bar{x}sh}$	= Standard error of hours fished by shore anglers	.9165	.4424
S_{sf}^2	= Variance of fish caught by shore anglers	2.6426	4.6087
$S_{\bar{x}sf}$	= Standard error of fish caught by shore anglers	.0648	.4382
$S_{\bar{x}shsf}$	= Combined standard error of hours fished and fish caught by shore anglers	.0491	.0055
$S_{\bar{x}sb}$	= Combined standard error of hours fished and fish caught for shore and boat anglers	.0491	.0278
HA_s	= Harvest by shore anglers	25,740	621
HA_b	= Harvest by boat anglers	55,319	1,288
HA	= Total harvest of game fish	81,059	1,909
R_{sb}	= Combined rate of success for boat and shore anglers	.4789	.3559
$S_{\bar{x}HA}$	= Standard error of harvest	2.38	35.35

MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION

JOB COMPLETION REPORT

RESEARCH PROJECT SEGMENT

State of Montana

Project No.: F-12-R-9 Name Western Montana Fishery Study

Job No.: I Title Inventory of Waters of the Project Area

Period Covered: May 1, 1962 through June 30, 1963

ABSTRACT:

Twenty-five streams and 28 lakes were surveyed during the report period. Eight of these lakes were waters on which follow-up survey information, or specific information concerning management measures was desired. Initial surveys were conducted on the remaining 20 lakes and all 25 streams. Management problems are discussed for Salmon, Rainy, Coopers and Bowman Lakes, and recommendations are given for all lakes surveyed.

Original survey data are filed in the district headquarters, copies of lake and stream survey cards for waters surveyed in the 1962 field season have been sent to Helena.

Opening day pressure and harvest information are presented for Browns Lake.

RECOMMENDATIONS:

Mountain Lakes

1. Alpine - No reproduction, good growth rate, plant 1,400 two-inch rainbow annually.
2. Carruthers - Natural reproduction, slow growth, remove from planting program.
3. Dora Thorn - Natural reproduction, remove from planting program.

4. Fourmile Basin #1 - Too small to manage.

5. Fourmile Basin #2 - Too small to manage.

6. Fourmile Basin #3 - Heavy population of brook trout, no stocking necessary.

7. Fourmile Basin #4 - No planting at present, survey again in 1964 or 1965 to determine success of golden trout reproduction.

8. Fourmile Basin #5 - Too shallow to manage.

9. Goat - Too shallow for fish.

10. Ivanhoe - Fair reproduction, no stocking necessary.

11. Johnson - Fair cutthroat population, no stocking necessary.

12. Little Racetrack - Good reproduction, no stocking necessary.

13. Meadow #1 - Overstocked, suspend from planting program for 4 years.

14. Meadow #2 - Overstocked, suspend from planting program for 4 years.

15. Meadow #4 - Partially winterkill presumed, remove from planting program.

16. Meadow #5 - Overstocked, suspend from planting program for 4 years.

17. Mountain Ben - Fair reproduction, many, small-sized fish, remove from planting program.

18. Sidney - Fair reproduction, remove from planting program.

19. Tamarack - Too shallow to manage.

20. Un-named - Too shallow for fish.

21. Un-named - Too shallow for fish.

Other Lakes

1. Salmon Lake - Repeat bottom net sets again in 1963. Repeat plant again in 1963 and continue evaluation of 3-inch rainbow trout stocking.

2. Middle Bowman Lake - Repeat gill net sets in the fall of 1963 to continue evaluation of changes in fish population due to raising water levels of the lake.

3. Coopers Lake - Gill net catches in June of 1963 indicate a large rough fish population. Consideration should be given to building a barrier in the outlet of the lake and rehabilitating the lake.
4. Rainy Lake - Sample fish population again in the fall of 1964. Continue publicity efforts concerning the large size and number of cutthroat trout to increase the harvest of mature fish.
5. Millers Lake - No change in present management plans.
6. Mud Lake - No change in present management plans.
7. Krohn - Stock with 780, 7- to 9-inch rainbow soon after ice break-up in 1964. Net again in late fall of 1964 to determine seasonal growth of stocked fish. Net again in the spring of 1965 for evidence of winter survival.

OBJECTIVES:

The primary objective of this job is to obtain basic information through general, initial surveys on waters from which no fish-population, physical, or chemical data are available.

A secondary objective is to conduct follow up surveys on waters where additional information is needed to evaluate management practices on specific waters.

TECHNIQUES USED:

Twenty-five streams and 28 lakes were surveyed by standard methods during the report period. Survey data were recorded on standard Montana forms and are filed in the district office. Duplicate file copies of the Lake and Stream survey cards for waters covered in the 1962 field season have been sent to Helena. File copies of the lake survey cards for waters surveyed in the 1963 season will be prepared.

The following is a list of common names, abbreviations used, and scientific names used for all species mentioned in this report.

Scientific and common names are those listed in the American Fisheries Society Special Publication No. 2, 1960.

Common Name	Abbreviation	Scientific Name
Kokanee	KOK	Oncorhynchus nerka (Walbaum)
Mountain whitefish	Wf	Prosopium williamsoni (Girard)
Cutthroat trout	Ct	Salmo clarki Richardson
Rainbow trout	Rb	Salmo gairdneri Richardson
Brown trout	LL	Salmo trutta Linnaeus
Brook trout	Eb	Salvelinus fontinalis Mitchill
Golden trout	Gt	Salmo aquabonita
Dolly Varden	Dv	Salvelinus malma (Walbaum)
Longnose sucker	F Su	Catostomus catostomus (Forster)
Largescale sucker	C Su Col.	Catostomus macrocheilus Girard
Sculpin	Cott	Cottus sp.
Northern Squawfish	SQ	Ptychocheilus oregonensis (Richardson)
Peamouth	CRC	Mylocheilus caurinus (Richardson)
Yellow perch	YP	Perca flavescens (Mitchill)
Pumpkinseed	PS	Lepomis gibbosus (Linneaus)

All lengths of fishes in this report are presented as total lengths in inches.

Mountain Lakes

A helicopter was used for transportation to survey 21 mountain lakes in the project area. Survey costs were charged to a state project, but, since the work done is closely related to this job, the data are included in this report. Lakes were surveyed by standard mountain lake methods, except where a lake's maximum depth was 20 feet or less, only depth, name and location were recorded.

FINDINGS:

Mountain Lakes

Forty-four hours and 40 minutes of helicopter flying time made the lake-survey transportation cost $3,350. This is $74.44 per lake which is $5 less than the lowest cost-per-lake we have had for rented, horse-back transportation. Extremes of the 21 lakes surveyed were 35 airline miles apart. Survey by horse-back would have taken at least 30 days, with the helicopter it took 13.

A list of the mountain lakes surveyed, showing location, area, number of nets set, numbers and species of fish collected, and average length and weight of fish by species is presented in Table 1. Growth rates for cutthroat, rainbow and brook trout are shown in Table 2.

Table 1. SUMMARIZATION OF MOUNTAIN LAKE SURVEY DATA, UPPER CLARK FORK RIVER DRAINAGE, JULY AND AUGUST 1962.

Lake	Location (County)	Area in acres (Est.)	Number of Net Sets	Species	Number caught	Average length (inches)	Average weight (pounds)
Alpine	Granite	17.5	2	Rb	2	20.4	4.45
Carruthers	Powell	8	1	Ct	49	7.6	0.13
Dora Thorn	Granite	3	1	Rb	2	13.2	0.73
				Ct	27	8.9	0.25
Four Mile Basin #1	Deer Lodge	3	1	Rb	3	9.5	0.42
Four Mile Basin #2	Deer Lodge	1	No sets made - Too shallow for fish				
Four Mile Basin #3	Deer Lodge	12	1	Gt	1	9.0	0.23
				Eb	42	7.8	0.16
Four Mile Basin #4	Deer Lodge	10	2	Gt	50	8.8	0.24
Four Mile Basin #5	Deer Lodge	4	2	None caught			
Goat	Powell	3	No sets made				
Ivanhoe	Granite	7	1	Rb	5	11.4	0.52
Big Johnson	Granite	75	2	Ct	15	8.8	0.20
Little Racetrack	Granite	3	1	Rb	6	15.6	1.39
				Ct	11	9.3	0.27
Meadow #1	Granite	6	1	Rb	14	9.0	0.29
				Ct	6	9.9	0.22
Meadow #2	Granite	5	1	Rb	32	7.3	0.13
Meadow #4	Granite	6	1	Rb	3	7.3	0.18
Meadow #5	Granite	5	1	Rb	24	8.1	0.23

Table 1. Continued

Lake	Location (County)	Area in acres (Est.)	Number of Net Sets	Species	Number caught	Average length (inches)	Average weight (pounds)
Mountain Ben	Powell	10	2	Rb	28	9.4	0.26
				Ct	18	9.0	0.22
Sidney	Granite	9	1	Rb	11	9.8	0.36
				Ct	19	10.7	0.41
Tamarack	Granite	6	1	No fish captured			
Unnamed	Powell	-	-	No sets made, too shallow for fish			
Unnamed	Powell	-	-	No sets made, too shallow for fish			

Table 2. AGE AND GROWTH OF TROUT, MOUNTAIN LAKES, 1962

Lake	Species	Average Length in Inches at Annulus I	II	III	IV
Alpine	Rb	4.0 (2)	9.9 (2)	15.5 (2)	18.5 (2)
Carruthers	Ct	3.7 (35)	6.2 (34)	6.7 (4)	
Dora Thorn	Rb	2.9 (2)	7.2 (2)	10.7 (2)	12.4 (2)
	Ct	5.0 (23)	7.7 (11)	9.8 (4)	
Four Mile Basin #1	Rb	4.3 (3)	7.4 (2)	10.2 (1)	
Four Mile Basin #3	Eb	3.5 (28)	6.8 (25)		
Ivanhoe	Rb	2.6 (4)	5.7 (4)	9.0 (4)	11.4 (2)
Big Johnson	Ct	3.2 (14)	6.3 (13)	8.5 (3)	
Little Racetrack	Rb	2.9 (6)	7.2 (6)	11.3 (6)	13.8 (5)
	Ct	3.9 (9)	6.6 (9)	8.7 (1)	
Meadow #1	Rb	3.2 (11)	6.2 (9)	9.1 (8)	10.0 (1)
	Ct	4.9 (5)	7.9 (5)	8.5 (1)	
Meadow #2	Rb	3.0 (32)	6.5 (23)		
Meadow #4	Rb	4.0 (3)	6.0 (2)		
Meadow #5	Rb	3.8 (19)	6.7 (19)	7.7 (5)	
Mountain Ben	Rb	2.4 (28)	6.1 (28)	8.6 (22)	
	Ct	3.5 (18)	7.1 (16)	8.3 (4)	
Sidney	Rb	2.6 (11)	6.6 (11)	9.6 (7)	10.0 (1)
	Ct	4.0 (19)	7.6 (19)	9.0 (11)	10.4 (1)

Numbers in parenthesis indicate sample size.

Salmon Lake

Summaries of the 1961 and 1962 catch data are shown in Table 3. The 1962 netting was done from October 23-26 and the 1961 from September 26-29, thus the kokanee spawning run was more advanced during the 1962 sampling, which probably accounts for the increased catch of this species. Of the 120 kokanee taken in 1962, 26 were immature and 94 were adults which were mostly ripe. The average length and weight of the immature salmon was 9.6 inches and 0.32 pounds, and of the adults was 12.6 inches and 0.71 pounds. Primarily due to this increased catch of kokanee and a decreased catch of perch and peamouth, the percent of game fish in the catch (by numbers) increased from 19.7 in 1961 to 28.8 in 1962.

Rainbow and cutthroat were very low in the catch in both years. The 1961 plant of 3- to 4-inch rainbow did not show up in the 1962 netting. Possibly they were still too small to be vulnerable to our smallest-sized mesh (3/4-inch square). Therefore Salmon Lake should be netted again in 1963.

Table 3. SUMMARIZATION OF SALMON LAKE CATCH DATA FOR 1961 and 1962

Species	CSuCol	SQ	CRC	F Su	YP	PS	Wf	KOK	Dv	LL	Rb	Ct
					1961							
No. caught	83	178	177	62	242	10	117	44	15	6	2	1
Ave. length	12.61	11.36	11.16	13.00	6.50	5.33	11.12	9.60	14.47	14.20	13.8	8.2
Ave. weight	.86	.52	.41	.73	.12	.14	.41	.33	.92	1.09	.87	.20
% of Total	8.86	19.00	18.89	6.62	25.83	1.07	12.49	4.70	1.60	.64	.21	.11
					1962							
No. caught	100	103	96	84	113	9	101	120	16	6	1	1
Ave. length	13.1	10.7	11.1	13.0	6.5	6.2	10.9	12.0	14.3	15.5	13.2	10.9
Ave. weight	0.86	0.47	0.49	0.80	0.12	0.19	0.40	0.62	1.32	1.13	0.80	0.44
% of Total	14.3	17.2	10.1	8.9	19.8	1.0	13.5	12.6	1.7	0.6	0.1	0.1

Rainy Lake

Rainy Lake, rehabilitated in 1958, was checked with 2 overnight gill net sets on October 18 and 19, 1963. The catch included 39 trout and 32 suckers. A comparison of the average catch per net of 1955-57 season with the 1962 season is shown in Table 4. Also included in the table is the number and average length of fish caught in 1962.

Table 4. RAINY LAKE CATCH DATA, 1955-62

Species	Average catch per net 1955-1957	Average catch per net 1962	Number caught (1962)	Average length (1962)
Cutthroat	0.6	16.0	32	11.5
Dolly Varden	1.2	3.0	6	14.8
Rainbow	0.0	0.5	1	17.4
Suckers (F Su & C Su)	6.5	16.0	31	9.3

Results of the average catch per net data show a considerable population increase of cutthroat trout in 1962 as compared to 1955-57 data.

The lake, supposed to have been replanted only with cutthroat in 1958, also revealed the presence of rainbow trout. Dolly Varden probably entered the lake from an untreated section of the Clearwater River above Rainy Lake.

Large numbers of suckers both longnose and largescale showed up in the catch. Apparently, the lake rehabilitation was successful in eliminating only northern squawfish, peamouth and yellow perch.

Few reports of angler success have been received to date. Although Rainy Lake possesses a good population of large cutthroat trout, fishing pressure is believed to be very light. Publicity has been given to the size and condition of fish captured and perhaps more pressure can be expected on this lake in the future. The lake should be resurveyed again in 1964.

Coopers Lake

Coopers Lake in Powell County was surveyed on June 12 and 13, 1963. Three overnight gill nets resulted in a catch of 112 longnose suckers, 101 northern squawfish, 1 cutthroat and 1 rainbow.

Because of the large population of rough fish, the possibility of rehabilitating this lake was discussed with local home-owners. Several barrier sites on the outlet stream were investigated and discussed with a local rancher. Plans to rehabilitate the lake should be considered.

Middle Bowman Lake

Middle Bowman Lake has been gill netted annually since 1960 to determine the effects of increased water levels and subsequent water fluctuations on the fish population. A special use permit was issued by the U. S. Forest Service to a landowner lower in the drainage to raise the water level of the lake 12 to 16 feet. The permit provides that the level of the lake will not be lowered below its natural level. The impounded water will be used for irrigation.

The dam construction began in 1960 and the lake was filled to its maximum level in 1962. Ten overnight gill net sets were made in 1960 followed by a series of 5 net sets in 1961 and 1962. All fish captured were weighed, measured and scale samples were taken.

The catch data from Middle Bowman Lake for 1960, 1961 and 1962 is shown in Table 5.

Table 5. CATCH DATA FROM MIDDLE BOWMAN LAKE 1960, 1961 and 1962

	Ave. Catch per set			No.of fish captured			Ave.length (inches)		
Species	'60	'61	'62	'60	'61	'62	'60	'61	'62
Ct	9.3	5.2	12.4	93	26	61	9.2	9.9	10.6
Rb	1.7	2.2	0.3	17	11	1	10.0	10.2	10.6

The average catch per net of cutthroat trout in 1962 was more than twice the average number caught in 1961 and slightly better than the average catch of 1960. The average catch per net of rainbow trout in 1963 showed a decrease from 1960 and 1961. The average length of both rainbow and cutthroat increased gradually from 1960 to 1963.

The growth rates of cutthroat trout for 1960, 1961 and 1962 are shown in Table 6.

Table 6. GROWTH RATES OF CUTTHROAT TROUT, BOWMAN LAKE 1960, 1961 and 1962.

	Average length in inches at Annulus			
	I	II	III	IV
1960	2.7	6.2	8.3	10.8
1961	2.8	6.1	8.9	
1962*	3.0	6.6	10.0	11.6

*All age group I over 4.9" were moved to age group II

The average length of cutthroat trout showed gradual increases in all size groups from 1960 to 1962.

The average catch per set, the average lengths and annual growth of cutthroat trout have increased since the survey was initiated in 1960. No detrimental effects to the cutthroat population are evident as a result of increasing the water level of Bowman Lake. The survey should continue again in 1963 to determine the affects of seasonal drawdowns on the present fishery.

Mud Lake

Mud Lake, a small pothole lake, was surveyed and found to have a good population of large rainbow along with a few cutthroat. One overnight gill net, set on June 12, 1963, caught 28 rainbow and 3 cutthroat trout, Table 7.

Table 7. AVERAGE LENGTH AND WEIGHTS OF RAINBOW AND CUTTHROAT TROUT CAPTURED IN MUD LAKE, JUNE 1963.

Species	No. in sample	Ave. length in inches	Range (inches)	Ave. weight in pounds	Range (Pounds)
Rb	28	10.1	(6.0-17.4)	0.57	(0.11 - 1.82)
Ct	3	8.9	(8.3- 9.6)	0.27	(0.20 - 0.40)

Access to this lake poses a problem as part of the shoreline entrance to the lake is on private land. The only public access to the lake is from the Bob Marshall Wilderness area side. No management changes are recommended.

Krohn Lake

Krohn Lake near Lincoln was surveyed and found to contain no fish. The lake is very productive and has a large population of food organism, mainly fresh water shrimp and caddis fly larvae.

An experimental plant of 780, 7- to 9-inch rainbow has been recommended for the spring of 1964 to obtain data on growth rates.

Krohn Lake is very shallow, with a maximum depth of 15 feet. Winter kills would probably be an annual occurrence. However, this productive lake may provide good seasonal fishing if good summer growth and harvest rates can be attained. The lake is on private land but the owner has agreed to permit public fishing if the lake is stocked.

Millers Lake

Millers Lake (Powell County), also known as Miller Creek Lake, has an area of 11 acres and was sampled with one 2-hour gill net set. During this short period, 45 longnose suckers, 2 rainbow and one cutthroat trout were captured.

The lake is used primarily for irrigation and watering stock and is subject to severe water fluctuations. At present, the lake is posted to fishing and fishing privileges are limited to a few local anglers. For this reason no future management plans have been proposed.

Stream Surveys

Blackfoot Streams

Initial surveys of six tributary streams to the Blackfoot River in the vicinity of Lincoln were made in July 1962. Surveys were made of Alice, Klondike, Stonewall, Beaver, Poorman and Keep Cool Creeks. Physical characteristics were recorded on stream survey forms. Survey data were obtained in conjunction with the observance of spruce budworm spraying in the area.

These streams are small, fast flowing spring-fed mountain streams that range from 5 to 18 feet in width and have a maximum depth of one foot. Stream flows ranged from 10 to 43 cfs. Small cutthroat trout in the 5- to 7-inch category are fairly abundant in most of these streams. Fishing pressure on these streams is generally regarded as light with the exception of Alice and Poorman Creek which receive the heaviest fishing pressure and have the best reputation of the local small streams.

Ninemile Streams

Initial surveys were made of 19 tributary streams to Ninemile Creek in August 1962. Physical characteristics are recorded on stream survey cards. Five of the creeks surveyed were found to be dry. These creeks were Marion, Little Blue, Kennedy, Stony and Spring Creeks. The remaining 14 streams surveyed were:

Beecher	Devils	Pine
*Big Blue	*Josephine	Rennic
*Burnt Fork	*Martina	*Soldier
Butler	Mattie V.	*St. Louis
*Camp	McCormick	

*May go dry during dry year

Most of the above streams surveyed are very small, contain small-sized fish and contribute little to the sport fishery. With the exception of Butler Creek, recorded stream flows ranged from 0.38 to 6.5 cfs. Butler Creek had a flow of 37.5 cfs. Stream widths ranged from 2 to 14 feet and

depth from .2 to .6 feet. Most of the streams contained cutthroat trout and in some cases brook trout were also present. Although accessibility to these streams is good via Ninemile Creek road, they are not popular because the fish do not attain a catchable size. A small dredge mill pool on Mattie V Creek was found to have a good population of 4- to 9-inch cutthroat.

Browns Lake Opening Day Creel Census

An opening day creel check was conducted at Browns Lake to determine an estimate of harvest and fishing pressure. Fishing pressure was extremely heavy in 1963 and many excellent catches of rainbow trout were made. Boats and shore fishermen were counted at three-hour intervals and 35 boats and 9 shore fishing parties were contacted during the day. The data obtained from anglers were: the number of fishermen in the party, the number of hours fished and the number of fish caught (rainbow trout). These data are presented in table 8.

Table 8. OPENING DAY CONTACT DATA, BROWNS LAKE, 1963.

	Parties contacted	Anglers per party	No. of Anglers	Ave. length of trip	Man-hours fished	Fish caught	CPMH*	Catch per trip
Boat fishermen	35	2.9	102	4.0	407	578	1.4	5.8
Shore fishermen	9	1.4	15	5.0	76	76	1.0	5.1

*Catch per man-hour

Boat fishermen averaged 1.4 fish per hour and 5.8 fish per trip as compared to 1.0 fish per hour and 5.1 fish per trip for shore anglers.

Estimates of total pressure and harvest are shown on Table 9. These are ratio estimates made from the contact data and the periodic boat and shore fishermen counts. An estimated 906 fishermen fished a total of 3834 hours and took 5020 fish. Boat anglers caught nearly four times the

number of fish as did the shore anglers.

Table 9. RATIO ESTIMATES OF OPENING DAY HARVEST AND FISHING PRESSURE, BROWNS LAKE, 1963

	No. Fishermen	No. hours fished	No. fish caught
Boat fishermen	696	2784	3960
Shore fishermen	216	1050	1060
Total	906	3834	5020

An opening day creel census should be repeated in 1964 to compare harvest and pressure estimates with the 1963 data.

Prepared by: Arthur N. Whitney and Robert J. Domrose

Date: May 1, 1964

Approved by George D. Holton
George D. Holton

JOB COMPLETION REPORT

RESEARCH PROJECT SEGMENT

2 3
1

State of Montana

Project No. F-12-R-8

Name Western Montana Fisheries Study

Job No. IV

Title Investigation of the Effects of U.S. Forest Service Forest Insect Control Program on Aquatic Life

Period Covered: May 1, 1961 - June 30, 1962

This was an investigation of the effects of U. S. Forest Service insect control program on aquatic life. No work done because the Forest Service did not conduct a spray program in District 2 in 1961.

Prepared by Arthur N. Whitney

Date October 3, 1962

Approved by George D. Holton
Asst. Coordinator

MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION
HELENA, MONTANA

JOB COMPLETION REPORT
INVESTIGATIONS PROJECTS

State of Montana

Project No. F-12-R-8 Name Western Montana Fishery Study

Job No. III Title Georgetown Lake Study

Period Covered May 1, 1961 - April 30, 1962

Abstract:

A partial creel census was conducted on Georgetown Lake during the fishing season of 1961. The total estimated pressure was 132,600 hours and the total harvest was 50,353 game fish. An estimated 30,400 fishing trips were made. The rate of success was just under 0.4 fish per hour. Hatchery rainbow and cutthroat trout, planted as fingerlings, comprised 86.7 per cent of the total catch.

Procedures and formulae for computation of estimates are recorded in detail for future census data analysis on Georgetown and similar Montana waters.

Recommendations:

1. Data to date indicate that rainbow trout provide better fishing than do Yellowstone cutthroat trout in Georgetown Lake. For this reason, it is recommended that rainbow trout fingerlings be substituted for the portion of the plant which is currently composed of cutthroat trout.
2. It is further recommended to continue creel census on Georgetown Lake during the 1962 summer fishing season. Methods and coverage should be identical to those employed in 1961. Days identical to those included in the sample in 1961 should be censused, to provide data for trend

analysis, as a further means of checking the reliability of estimates.

Objectives:

The objective of the Georgetown Lake summer creel census was to obtain data for making estimates of fishing pressure and total game fish harvest. Data obtained from the creel census will be used in formulation of future fishery management plans for the lake.

Techniques Used:

Georgetown Lake has been planted with a variety of trout and salmon species in the past (Averett and Whitney, 1959), and has received annual plants of 150,000 each of three to four-inch cutthroat and rainbow trout since 1958.

Special season opening and closing dates have been in effect on Georgetown Lake for a number of years. In 1961, the fishing season opened on June 25 and closed on October 31. Creel census was initiated on June 25, and continued according to schedule until the fishing season was closed.

Contact information requested from anglers included the following:

1. Fishing license number.
2. Residence (within or outside of 40 mile radius of lake, or non-resident).
3. Length of fishing trip.
4. Total fish caught.
5. Species of fish (with fin clip, if applicable).
6. Boat or shore fisherman.

The schedule for operation of the creel census was patterned after that described by Neuhold and Lu, 1957. This type of creel census employs both through-fishermen contacts and instantaneous boat and shore angler counts. Counts on Georgetown Lake took from 45 to 60 minutes, but were considered instantaneous for census purposes.

In addition to counts of boats made at regularly scheduled times, the census technician was instructed to obtain a count of fishermen per boat

from a number of boats. This was done to prevent delay while making scheduled boat counts and because usually, while boats could be discerned from a distance, the number of anglers in those boats could not be counted. These counts, which were not scheduled, will be termed hereafter as independent boat counts.

Opening day was considered a separate strata and censused accordingly. One census technician conducted instantaneous counts of shore fishermen and the number of fishing boats. Five counts were made throughout the day. The first count was made at 0600 and the last count at 1900. Two crews of two men each were assigned an area of the lake on which to contact angler parties as they left the area.

Approximately 50 per cent of the remaining days in the fishing season were included in the sampling schedule for census. Beginning on June 26, the fishing season was stratified into two-week periods. Seven days were chosen randomly from each strata, with the restriction that no day of the week would be included twice during a two-week period. One census technician conducted two counts of boats and shore anglers each census day, and made completed trip angler contacts during the times that counts were not being made.

Times at which counts were made were selected by stratifying each census day into four, 4-hour periods. Since two counts each day were required, two periods each day were randomly selected giving equal representation to each period throughout the season. The hour of the count was selected at random, initially, from each time period, and then systematically selected.

Because of the length of the sampling schedule, the actual schedule is not presented in this report. Copies of the schedule are on file at district headquarters.

Marked fish:

Portions of the plants of hatchery-reared fish during the years 1958 through 1960 were distinctively marked to establish the contribution by hatchery fish to the Goergetown Lake fishery.

During these years, approximately 300,000, 3-4 inch rainbow and cutthroat trout were planted each year. One-third of the number of each species planted were marked. In 1958, the right premaxillary bone was removed; in 1959, the left premaxillary bone was removed; and in 1960, the adipose fin was removed.

Findings:

The following species of game fish contribute to the Georgetown Lake fishery:

Common name	Abbreviation	Scientific name
Cutthroat trout	Ct	Salmo clarki Richardson
Rainbow trout	Rb	Salmo gairdneri Richardson
Brook trout	Eb	Salvelinus fontinalis Mitchill
Arctic grayling	Gr	Thymallus arcticus (Pallas)
Kokanee	KOK	Oncorhynchus nerka (Walbaum)

Census technicians recorded the species of 1,175 fish caught by Georgetown Lake anglers. Numbers of fish and the per cent of the total recorded catch these fish represented, are presented by species and mark in Table 1.

Table 1. SPECIES COMPOSITION OF RECORDED CATCH, GEORGETOWN LAKE, 1961.

	Species											
	Ct'	Ct*	Ct**	Ct***	Rb'	Rb*	Rb**	Rb***	Eb	Gr	KOK	Total
No.	290	23	64	26	484	44	168	14	44	8	10	1,175
%	24.7	2.0	5.4	2.2	41.2	3.8	14.3	1.2	3.7	.7	.8	100.0

'Trout with no clip
*Trout with 1958 clip
**Trout with 1959 clip
***Trout with 1960 clip

The total per cent of marked fish recorded in the anglers catch is 28.9 per cent. Since one-third of the fish planted were marked, an estimated 86.7

per cent of the total harvest of fish from Georgetown Lake were planted fish.

Marked cutthroat trout comprised 9.6 per cent of the recorded catch, and marked rainbow trout 19.3 per cent, which would indicate that planted rainbow trout provided more fishing than did cutthroat trout.

A total of 471 individual license-holders, who made 642 fishing trips to Georgetown Lake, were contacted by census personnel. Of these 471 anglers, 183, or 38.85 per cent, caught no fish. The distribution of the catch among individual license holders at approximate 5, 10, and 25 per cent levels is presented in Table 2. Per cents expressed are derived by cumulative addition of anglers who caught the most fish to those who caught fewer fish.

Table 2. DISTRIBUTION OF THE CATCH OF LICENSE HOLDERS CONTACTED, AND THE PORTION OF EFFORT EXPENDED BY VARIOUS PER CENT LEVELS OF THE MOST SUCCESSFUL ANGLERS, GEORGETOWN LAKE, 1961.

Per Cent of Total		
Anglers Contacted	Trips made	Fish caught
5.31	12.93	33.33
9.98	17.76	47.45
28.02	37.54	78.18

These findings are similar to the distribution of the catch among anglers who fished Rock Creek in 1960 (Boland, 1961). Georgetown Lake anglers made a smaller per cent of the angling trips to attain identical levels of catch distribution than did Rock Creek anglers.

Statistical procedures for obtaining total estimates of angling pressure and harvest, and the precision of these estimates, were patterned after those described by Neuhold and Lu, 1957. Some modifications of formulae for calculating fiducial limits when standard errors are combined were made. The method of propogation of error is that described by Arkin and Colton, 1953. Tests for independence were made following methods described by Dixon and Massey, 1957.

A detailed description of the statistical analysis of the 1961 Georgetown creel census data is presented to facilitate comprehension of the analysis. Procedures recorded in this report will likely be used for analysis of data from other Montana waters where the mechanical problems of conducting a creel census are similar to those encountered on Georgetown Lake.

As previously stated, the Georgetown Lake fishing season opened on June 25, and was closed on October 31. Opening day was sampled as a separate strata and separate estimates were made. The estimates of harvest and angling pressure for opening day were computed in an identical manner as were estimates for the remainder of the season. For this reason, no formulae or statistical procedures will be described for opening day.

Count data from the entire season are presented in Table 3. All statistics, and their values, are described in Appendix A. Final estimates of angling pressure and harvest are included in Table 4.

Opening day estimates:

Estimates of angling pressure, harvest, and the rate of success obtained for opening day are presented in Table 4. The extremely wide confidence limits for the combined boat and shore angler pressure estimate is a function of the extreme variation in the numbers of boats and shore anglers counted at various count times on opening day.

The basic unit of angling pressure is expressed in terms of hours fished. Contact data from 165 boat and shore anglers on opening day indicate that the average length of fishing trip was 4.42 hours. To obtain an approximate estimate of the number of anglers fishing Georgetown Lake on opening day, the combined boat and shore point estimate was divided by 4.42, resulting in an estimate of 5,352 fishing trips on opening day.

Table 3. SHORE FISHERMAN AND BOAT COUNTS, GEORGETOWN LAKE, 1961.

Date	Boat(X)	Shore(Y)	Date	Boat(X)	Shore(Y)	Date	Boat(X)	Shore(Y)
June 25	904	993	Aug. 11	10	12	Oct. 2	4	14
	426	841		17	21		0	68
	121	348	12	6	12	5	4	11
	42	223		11	28		0	57
	27	146	16	8	9	6	1	16
26	49	42		11	16		0	49
	26	47	17	10	5	10	0	5
28	23	36		14	36		0	17
	14	62	20	13	33	11	0	2
29	17	37		19	62		0	12
	11	72	21	2	5	14	1	15
July 1	14	51		3	11		0	32
	22	73	22	3	9	15	2	65
2	53	112		12	22		0	84
	16	78	23	11	18	17	0	7
4	16	23		4	19		0	22
	21	49	26	17	37	18	0	1
7	8	24		36	81		0	4
	19	46	27	31	46	23	0	3
10	17	20		42	87		0	7
	6	22	31	10	15	26	0	0
11	13	13		4	26		0	2
	8	12	Sept. 1	0	3	27	0	0
14	9	12		3	17		0	9
	10	14	4	14	24	28	0	1
15	20	28		19	35		0	17
	19	31	5	7	16	29	0	8
19	20	56		0	19		0	13
	35	56	6	3	6			
20	8	11		4	11			
	12	38	14	11	15			
23	15	65		3	81			
	18	59	15	2	15			
26	15	18		6	22			
	11	18	16	3	6			
27	6	9		1	104			
	14	46	17	15	77			
29	11	27		12	81			
	17	62	19	4	3			
31	5	13		5	67			
	5	23	20	2	12			
Aug. 1	7	24		0	11			
	32	79	21	2	2			
4	13	4		2	3			
	17	42	24	3	11			
6	19	23		3	46			
	18	47	25	0	1			
7	9	3		1	13			
	8	35	29	0	7			
8	13	42		0	38			
	11	56						

Opening Day:

$\Sigma X = 1,520$

$\Sigma X^2 = 1,015,826$

$\Sigma Y = 2,551$

$\Sigma Y^2 = 1,885,479$

June 26 - Oct. 29:

$\Sigma X = 1,181$

$\Sigma X^2 = 24,235$

$\Sigma Y = 3,657$

$\Sigma Y^2 = 187,713$

June 26 - October 31 estimates:

Beginning on June 26, there were 128 days in the season. The legal angling day began at 0500 and lasted until 2200. There were 17 possible fishing hours each day, or 2,176 possible fishing hours throughout this portion of the season.

Table 4. SHORE AND BOAT FISHING PRESSURE, SUCCESS RATES, AND HARVEST, GEORGETOWN LAKE, 1961.

	Confidence Interval ($t_{.95}$)		
	Lower Limit	Point Estimate	Upper Limit
Opening Day			
Shore fishing pressure	629	8,670	16,711
Boat fishing pressure	7,142	14,987	22,832
Combined shore & boat pressure	12,427	23,657	34,887
Combined shore & boat rate of success	.3652	.3908	.4164
Combined shore & boat total harvest	6,139	9,245	12,351
June 26 - Oct. 31			
Shore fishing pressure	54,400	64,170	73,940
Boat fishing pressure	41,101	44,746	48,391
Combined shore & boat pressure	98,276	108,916	119,556
Combined shore & boat rate of success	.3553	.3774	.3995
Combined shore & boat total harvest	37,093	41,108	45,123
Season Totals			
Hours pressure	110,703	132,573	154,443
Harvest	43,232	50,353	57,474

Creel census was conducted on 62 of the 128 days in the season. Two counts of shore anglers and boats were made each day, totaling 124 counts. During these counts, a total of 3,657 shore anglers and 1,181 boats were counted.

Shore fishing pressure:

The estimate of shore angling pressure was obtained by the following:

$$P_s = (\bar{X}_s)(H)$$

$$= (29.49)(2{,}176) = 64{,}170 \text{ hours.} \qquad (1)$$

To determine the precision of the shore pressure estimate, the variance of shore fishermen per count is calculated by the following:

$$S_s^2 = \frac{\Sigma Y^2 - \frac{(\Sigma Y)^2}{N}}{N-1} = \frac{187{,}713 - \frac{(3{,}657)^2}{124}}{123} = 649, \qquad (2)$$

where Y = the number of shore anglers each count.

The standard error of the mean shore anglers per count is derived by,

$$S_{\bar{x}s} = \sqrt{\frac{S_s^2}{N}} = \sqrt{\frac{649}{124}} = 2.29. \qquad (3)$$

The standard error of the mean follows a t- distribution with 123 degrees of freedom. The confidence limits to the mean are:

$$C.L._{.95} = \bar{X}_s \pm (t_{.95})(S_{\bar{x}s})$$

$$= 29.49 \pm (1.96)(2.29)$$

$$= 29.49 \pm 4.49 \text{ anglers per count,} \qquad (4)$$

and is expanded to

$$C.L._{.95} = (\bar{X}_s)(H) \pm (4.49)(H)$$

$$= 64{,}170 \pm 9{,}770 \text{ fisherman hours.} \qquad (5)$$

The point estimate of shore fisherman hours is then 64,170 hours, with a lower limit of 54,400 hours and an upper limit of 73,940 hours.

Boat fishing pressure:

During the 124 counts, 1,181 fishing boats were counted. The boat fishing pressure is obtained from the following:

$$P_b = (H)(\bar{X}_b)(\bar{X}_r) = (2{,}176)(9.52)(2.16) = 44{,}746 \text{ boat fisherman hours.} \qquad (6)$$

To obtain the precision of the boat fishing pressure estimate, the combined standard errors of the means of boats per count and fishermen per boat are used for determining the confidence interval. Since boats per count and the mean number of fishermen per boat can be considered to be independent, the following formula is used to calculate the combined standard error of the two means:

$$S_{\bar{x}_{br}} = \sqrt{\left(S_{\bar{x}_b}\right)^2 + \left(S_{\bar{x}_r}\right)^2} \qquad (7)$$

Values for formula (7) are obtained in the same manner as formulas 2 and 3 from the following, using data from Table 3:

$$S_{\bar{x}_b} = \sqrt{\frac{S_b^2}{N}} = \sqrt{\frac{105.5}{124}} = \sqrt{0.8508} = 0.922 \qquad (8)$$

The standard error of the mean number of fishermen per boat is determined from data obtained from independent boat counts (Table 5.) in an identical manner as was done in formula (8).

Then,

$$S_{\bar{x}_r} = \sqrt{\frac{S_r^2}{N}} = \sqrt{\frac{15.04}{115}} = \sqrt{0.1307} = 0.361 \qquad (9)$$

Table 5. INDEPENDENT COUNTS OF NUMBER OF ANGLERS PER BOAT.

Boats(X)	Anglers(Y)	Boats(X)	Anglers(Y)	Boats(X)	Anglers(Y)	Boats(X)	Anglers(Y)
3	7	1	1	4	11	2	3
3	6	2	7	7	16	2	4
2	3	3	5	3	6	3	8
3	8	3	7	2	4	1	2
7	18	5	9	5	12	4	8
2	5	1	4	6	8	1	2
3	5	4	9	3	5	1	2
5	16	2	3	1	2	2	3
3	10	6	11	4	7		
2	4	2	3	2	4		

$\Sigma X = 115$ $\Sigma Y = 248$ $N = 38$

$\Sigma X^2 = 449$ $\Sigma Y^2 = 2250$ $\Sigma XY = 977$

$\Sigma x^2 = \Sigma X^2 - (\Sigma X)^2/N = 101$ $\Sigma y^2 = \Sigma Y^2 - (\Sigma Y)^2/N = 632$ $\Sigma xy = \Sigma XY - (\Sigma X)(\Sigma Y)/N = 227$

Formula (10) (11) (12)

The formula to obtain the combined standard error is then:

$$S_{\bar{X}_{br}} = \sqrt{.8508 + .1307}$$
$$= 0.9907 \qquad (13)$$

The confidence interval at the 95 per cent confidence level with 36 degrees of freedom is:

$$C.L._{.95} = P_b \pm (t_{.95})(S_{\bar{X}_{br}})\ (H)$$
$$= 44{,}746 \pm (1.690)\ (0.9907)\ (2{,}176)$$
$$= 44{,}746 \pm 3{,}645 \qquad (14)$$

The point estimate is 44,746 boat fisherman hours with a lower limit of 41,101 hours and an upper estimate of 48,391 hours.

Combined shore and boat angling pressure:

The combined shore and boat angling pressure is obtained by adding estimates obtained above. In this manner:

$$T.P. = P_s + P_b$$
$$= 108{,}916 \text{ fishermen hours.} \qquad (15)$$

For the purpose of this study the shore and boat fisherman pressures are considered independent. The standard error of the combined estimate is obtained as follows:

$$S_{\bar{x}_{T.P.}} = \sqrt{\left(S_{\bar{x}_{br}}\right)^2 + \left(S_{\bar{x}_s}\right)^2}$$
$$= \sqrt{(.9907)^2 + (2.29)^2} = \sqrt{9.815 + 5.2441} = \sqrt{6.2256} \qquad (16)$$
$$= 2.495$$

The precision of the estimate with 123 degrees of freedom is then:

$$C.L._{.95} = T.P. \pm (t_{.95})\ (S_{\bar{x}_{T.P.}})\ (H)$$

$$= 108{,}916 \pm (1.96)\ (2.495)\ (2{,}176)$$

$$= 108{,}916 \pm 10{,}640 \qquad (17)$$

The point estimate of total fishing pressure is 108,916 angler hours, with a lower and upper limit of 98,276 and 119,556 angler hours.

Number of fishing trips:

An estimate of the number of angler trips is calculated by dividing the total pressure estimate by the average length of fishing trip, which was 4.35 hours for boat and shore fishermen combined. This calculation resulted in an estimate of 25,038 fishing trips to Georgetown Lake from June 26 to October 31, and by adding the opening day estimate of 5,352 trips, the season total is 30,390 trips. Because the basic unit of pressure is expressed in terms of hours fished, confidence limits were not calculated for the number of fishing trips.

Rate of success:

The rate of angling success is first calculated for shore and boat anglers separately, and then the standard errors are combined to establish a fiducial interval around the combined shore and boat angler rate of success. The rate of success for boat anglers is calculated by:

$$R_b = \frac{F_b}{H_b} = \frac{346}{648} = .5058 \qquad (18)$$

and similarly, for shore anglers is,

$$R_s = \frac{F_s}{H_s} = \frac{535}{1858} = .2879. \qquad (19)$$

To obtain the combined weighted rate of success, it is necessary to compute the estimate of harvest separately for boat and shore fishermen, since the two rates were not identical. This is done as follows:

$$HA_s = (P_s)(R_s) = (64,170)(.2879) = 18,475 \text{ fish, and}$$

$$HA_b = (P_b)(R_b) = (44,746)(.5058) = 22,633 \text{ fish.}$$

The combined weighted rate of success is then:

$$R_{sb} = \frac{HA_s + HA_b}{P_s + P_b} = \frac{41,108}{108,916} = 0.3774.$$

Values used to compute the standard errors of the rates of shore and boat anglers are presented in Table 6. Values for $\Sigma_x{}^2$, $\Sigma_y{}^2$, $\Sigma_{x_1}{}^2$, and $\Sigma_{y_1}{}^2$, are corrected values obtained by using formulas (10), (11), and (12), and inserting the appropriate values for computation.

Table 6. STATISTICS USED IN COMPUTING STANDARD ERRORS FOR RATES OF SUCCESS.

Boat				Shore			
Hours fished X		Fish caught Y		Hours fished X_1		Fish caught Y_1	
ΣX	= 684	ΣY	= 346	ΣX_1	= 1,858	ΣY_1	= 535
ΣX^2	= 3,060	ΣY^2	= 1,782	$\Sigma X_1{}^2$	= 10,090	$\Sigma Y_1{}^2$	= 2,097
N	= 173	N	= 173	N	= 411	N	= 411
$\bar{X}$	= 3.9537	$\bar{X}$	= 2.00	$\bar{X}$	= 4.5206	$\bar{X}$	= 1.3017
$\Sigma_x{}^2$	= 356	$\Sigma_y{}^2$	= 1,090	$\Sigma_{x_1}{}^2$	= 1,691	$\Sigma_{y_1}{}^2$	= 1,401

To determine the combined standard error of the mean number of hours fished and fish caught by boat anglers:

$$S_{\bar{x}_{bhbf}} = \left(\frac{S_{\bar{x}_{bh}}}{\bar{x}_{bh}}\right)^2 + \left(\frac{S_{\bar{x}_{bf}}}{\bar{x}_{bf}}\right)^2 = \left(\frac{.1091}{3.9537}\right)^2 + \left(\frac{.1913}{2}\right)^2$$

$$= (.0275)^2 + (.0956)^2 = .0098. \qquad (20)$$

A similar formula is used to combine the standard errors of hours fished and fish caught by shore fishermen:

$$S_{\bar{x}_{shsf}} = \left(\frac{S_{\bar{x}_{sh}}}{\bar{x}_{sh}}\right)^2 + \left(\frac{S_{\bar{x}_{sf}}}{\bar{X}_{sf}}\right)^2 = \left(\frac{.100}{4.5206}\right)^2 + \left(\frac{.091}{1.3017}\right)^2$$

$$= (.0221)^2 + (.0699)^2 = .0054. \qquad (21)$$

To obtain the combined standard error of hours fished and fish caught by both shore and boat anglers, the standard errors were considered independent and were computed as follows:

$$S_{\bar{x}_{sb}} = \sqrt{\left(S_{\bar{x}_{bhbf}}\right)^2 + \left(S_{\bar{x}_{shsf}}\right)^2} \qquad (22)$$

$$= \sqrt{(.0098)^2 + (.0054)^2} = .01127.$$

The fiducial interval at the .95 level is placed around the point estimate by:

$$C.L. = .3774 \pm (t_{.95})(S_{\bar{x}_{sb}}) \qquad (23)$$

$$= .3774 \pm (1.96)(.01127)$$

$$= .3774 \pm .0221$$

and the lower limit is determined to be .3553 fish, the point estimate .3774 fish and the upper limit .3995 fish per hour.

Harvest

The calculation of the harvest of game fish during the June 26 to October 31 period is based on the combined boat and shore rate of success times the estimate of hours fished, as:

$$HA = (T.P.)(R_{sb}) \qquad (24)$$

$$= (108{,}916)(.377428) = 41{,}108 \text{ fish.}$$

To test for dependency, the correlation coefficient for angling pressure and the rate of success was calculated. The correlation was only .088, so these variables were considered independent.

The standard errors for angling pressure and the rate of success are combined to establish fiducial limits by:

$$S_{\overline{X}HA} = \sqrt{\left(S_{\overline{X}T.P.}\right)^2 + \left(S_{\overline{X}sb}\right)^2} \quad (25)$$

$$= \sqrt{(2.495)^2 + (.01127)^2} = \sqrt{6.2262}$$

$$= 2.495$$

The confidence interval is then:

$$C.L. = 41,108 \pm \left[(S_{\overline{X}HA})(t_{.95})\right]\left[(H)(R_{sb})\right] \quad (26)$$

$$= 41,108 \pm (4.89)(821.22)$$

$$= 41,108 \pm 4,015$$

The point estimate of harvest is then 41,108 game fish, with a lower limit of 37,093 and an upper limit of 45,123 fish.

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Prepared by Boland, R. W. and Leik, T. Approved by George D. Holton

Date July 31, 1962

Appendix A

SYMBOL DEFINITIONS AND VALUES OBTAINED FOR PERIOD FROM JUNE 26 TO OCTOBER 31, AND OPENING DAY, GEORGETOWN LAKE, 1961.

		June 26 - Oct. 31	Opening Day
N	= Number of counts	124	5
P_s	= Shore fishing pressure in hours	64,170	8,670
$\bar{X}_s$	= Average number of shore fishermen per count	29.49	510
H	= Possible fishing hours in period	2,176	17
S_s^2	= Variance of shore angler counts	649	145,989
$S_{\bar{x}s}$	= Standard error of mean shore anglers per count	2.29	170.9
P_b	= Boat fishing pressure in hours	44,746	14,987
$\bar{X}_b$	= Mean number of boats per count	9.52	304
$\bar{X}_r$	= Mean number of anglers per boat	2.16	2.9
S_b^2	= Variance of boats per count	105.5	138,436
$S_{\bar{x}b}$	= Standard error of mean number of boats per count	.922	166.4
S_r^2	= Variance of anglers per boat	15.04	.55
$S_{\bar{x}r}$	= Standard error of the mean number of anglers per boat	.361	.235
$S_{\bar{x}br}$	= Combined standard error for boats per count and anglers per boat	0.9907	166.6
T.P.	= Combined shore and boat pressure in hours	108,916	23,657
$S_{\bar{x}T.P.}$	= Standard error combined shore and boat pressure	2.495	238.5
R_b	= Rate of success for boat anglers, expressed as fish per hour	.5058	.4356
F_b	= Total fish caught by boat anglers contacted	346	230
H_b	= Total hours fished by boat anglers contacted	684	528
N_b	= Number boat anglers contacted	173	110
$\bar{X}_{bh}$	= Mean number of hours fished by boat anglers	3.9537	4.80

Appendix A (Continued)

S_{bh}^2	= Variance of hours fished by boat anglers	2.0697	3.4403
$S_{\bar{x}bh}$	= Standard error for hours fished by boat anglers	.1091	.1766
$\bar{X}_{bf}$	= Mean number of fish caught by boat anglers	2.0	2.0909
S_{bf}^2	= Variance of fish caught by boat anglers	6.3372	5.5412
$S_{\bar{x}bf}$	= Standard error fish caught by boat anglers	.1913	.2242
$S_{\bar{x}bhbf}$	= Combined standard error of hours fished and fish caught by boat anglers	.0098	.0128
R_s	= Rate of success for shore fishermen, expressed as fish per hour	.2879	.3134
F_s	= Total fish caught by shore anglers contacted	535	63
H_s	= Total hours fished by shore anglers contacted	1858	201
N_s	= Number of shore anglers contacted	411	55
$\bar{X}_{sh}$	= Mean number of hours fished by shore anglers	4.5206	3.6545
$\bar{X}_{sf}$	= Mean number of fish caught by shore anglers	1.3017	1.1454
S_{sh}^2	= Variance of hours fished by shore anglers	4.1243	1.8703
$S_{\bar{x}sh}$	= Standard error of hours fished by shore anglers	.100	.1843
S_{sf}^2	= Variance of fish caught by shore anglers	3.4170	3.277
$S_{\bar{x}sf}$	= Standard error of fish caught by shore anglers	.091	.2439
$S_{\bar{x}shsf}$	= Combined standard error of hours fished and fish caught by shore anglers	.0054	.0029
$S_{\bar{x}sb}$	= Combined standard error of hours fished and fish caught for shore and boat anglers	.01127	.0131
HA_s	= Harvest by shore anglers	18,475	2,717
HA_b	= Harvest by boat anglers	22,633	6,528
HA	= Total harvest of game fish	41,108	9,245
R_{sb}	= Combined rate of success for boat and shore anglers	.3774	.3908
$S_{\bar{x}HA}$	= Standard error of harvest	2.495	238.5

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Montana Fish and Game Department
Fisheries Division
Helena, Montana

JOB COMPLETION REPORT
RESEARCH PROJECT SEGMENT

State of Montana

Project No.: F-12-R-8

Name: Western Montana Fishery Study

Job No.: II

Title: Population Survey of Rattlesnake Creek, O'Brien Creek, and Flower Creek

Period Covered: May 1, 1961 - June 30, 1962

ABSTRACT:

Rattlesnake Creek and O'Brien Creek were sampled by electrofishing during the report period. Populations of trout were found to have increased in numbers in both streams since the 1960-61 report period. The numbers of cutthroat of a catchable size in O'Brien Creek was lower than in 1960; while the numbers of catchable-sized brook trout showed an increase. The increase in all sizes of brook trout from 1960 to 1961 was 72 percent while the increase in numbers of all sizes cutthroat trout was only 21 percent. Population data from Rattlesnake Creek indicate that peak populations occurred in the summer of 1960 followed by a sharp decline early in 1961. Population numbers and weight appear to have increased in this stream during this report period. Flower Creek was not sampled because of road construction blocking passage into the sampling sections.

Creel census information was collected during the last of May and during June, 1962 from O'Brien Creek. This stream was opened to angling commencing with the 1962 fishing season for the first time since about 1925. Angler success was high; 1.03 fish per hour. Cutthroat trout made up 85 percent of the catch while brook trout made up 15 percent of the catch.

Recommendations:

The following recommendations are made for the continuance of the O'Brien Creek study:

1. Time and man-power permitting, creel census information should be collected during the remainder of the 1962 fishing season.

2. Fall fish population sampling should be continued using techniques similar to previous years.

The following recommendations are made for the continuance of the Flower Creek study:

1. This stream should be resurveyed in the fall of 1962, and, if possible,

PLEASE RETURN

opened to angling in 1963.

The following recommendations are made for the continuance of the Rattlesnake Creek study:

1. Fish population sampling should be continued for several years under the closed-to-angling situation. Sampling procedures should remain similar to those already used.

2. Age and growth data should be collected during the next work year.

OBJECTIVES:

Rattlesnake Creek, O'Brien Creek, and Flower Creek are respectively sources of domestic water for the towns of Missoula, Troy, and Libby, Montana. As such, these streams have been closed to angling above the water intakes for at least the past thirty years. It has been assumed from this fact that these three streams should represent a stream fishery in a near "virgin" condition.

Long term objectives of this study include sampling of the stream populations in their present state for at least two years. After this information has been gathered, it is planned that the streams will be opened to fishing if agreement can be reached with the towns and companies involved. Catch data will be collected along with information on the effects of angler harvest on the fish populations.

These data should help give an insight into the proper management of trout in streams such as these. Of special interest are the problems involved in the management of the stream-living cutthroat trout (Salmo Clarki).

Objectives during this report period were to continue population sampling on all three streams in a manner similar to previous years' work. One stream, O'Brien Creek, was opened to angling commencing with the 1962 general Montana fishing season. Creel census information was collected from this stream during the portion of the fishing season covered by this report.

Techniques used: O'Brien Creek

The fish population of O'Brien Creek was sampled once during the report period, in October, 1961. Only three of the four 1960 sampling stations were resampled, but three new stations were sampled. Figure 1 gives the locations of the sampling stations. Sampling was done by electrofishing in the manner described by Huston (1961). Fish captured were recorded by species, length, and weight.

O'Brien Creek, above the city water intake, has been closed to angling since about 1925 while the area below this water intake has been open to angling. Starting with the opening of the regular fishing season on May 21, 1962 the stream above the water intake was opened to angling. Creel census information was collected periodically during the portion of the 1962 fishing season covered by this report period; May 21 - June 30. A semi-permanent census station was set up on the principle road leading into the fishing area. Information collected from each angler included number, length, and species of fish caught; hours fished, type of lure, and age,

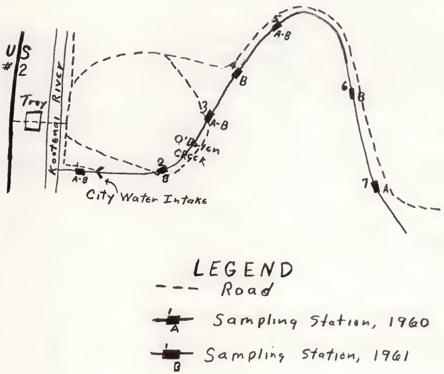

Figure 1. O'Brien Creek sampling stations

sex, and residence of the angler.

Findings: O'Brien Creek Population Survey

Six sampling sites were electrofished in 1961. These data will be presented here, as will a resume of the 1960 data collected from four sampling stations. Species of fish collected from O'Brien Creek during 1960 and 1961 included the cutthroat trout (*Salmo clarki*), brook trout (*Salvelinus fontinalis*), rainbow trout (*Salmo gairdneri*), and Dolly Varden (*Salvelinus malma*). Table 1 gives the results of the population sampling by section for 1960 and 1961. Section 1 lies below the city water intake and is in the area that has been open to fishing. Sections 2 - 7 lie above the water intake and are in the stream areas opened to angling beginning May 21, 1962.

O'Brien Creek in the vicinity of section 1 has a summer flow of about 20-25 cfs and is enclosed in a deep narrow V-shaped canyon. The stream in the vicinity of sections 2-5 also has summer flows of about 20 cfs. Here it lies in a U-shaped canyon and flows through a marshy meadowland. Much of the stream flow originates from springs and seep in these meadows. Beaver dams, both in the main channel and on side channels, are numerous in this area. Stream flows near section 6 and 7 are in the magnitude of 5 cfs. Here the stream is contained in a V-shaped canyon.

Table 1. Electrofishing catch by sections, O'Brien Creek, 1960 and 1961

Section	Year Sampled	Cutthroat No.	Cutthroat Lb.	Brook No.	Brook Lb.	Rainbow No.	Rainbow Lb.	D. Varden No.	D. Varden Lb.	TOTAL No.	TOTAL Lb.
1	1960	6	0.59	3	0.18	7	0.89			16	1.66
1	1961	10	0.71	7	0.72	1	0.05			18	1.48
2	1961	27	2.22	11	0.42			2	0.04	40	2.68
3	1960	24	3.11	23	1.32			2	4.34	49	8.77
3	1961	30	1.86	15	0.51					45	2.37
4	1961	25	1.87	81	4.07					106	5.94
5	1960	33	6.05	21	0.66					54	6.71
5	1961	24	4.42	8	0.18			1	0.01	33	4.60
6	1961			73	6.11					73	6.11
7	1960	4	0.39	32	2.35					36	2.74

The data given in Table 1 show differences between sections and groups of sections. Section 1 appears to have a lower fish population than the other sections. Sections 6 and 7 are comprised mostly of brook trout with very few cutthroat trout. Sections 2 through 5 combined contained about equal numbers of brook trout and cutthroat trout, but the cutthroat weighed much more than the brook trout. It is thought that the rainbow trout from section 1 and the two large Dolly Varden from section 3 are migrants from the Kootenai River and not true members of the resident population. These two species of fish will not be mentioned further in this report.

The data in Table 1 indicates that changes have occurred in the cutthroat and brook trout population of the stream. A length-frequency distribution is presented in Figure 2. Only fish from section 2 through 7 have been used. This data shows that 2 to 4-inch brook trout were the most numerous size class of this species in 1961 while the 4 to 6-inch class was the most numerous in 1960. Age-growth data presented by Huston (1961) indicate that brook trout in the 4 to 6-inch class would be in age-group II while fish in the 2 to 4-inch class would be in age-group I.

The 4 to 6-inch cutthroat were the most abundant class for this species in both 1960 and 1961. Fish of this size-class would probably be two-year olds. This size class made up 57 percent of the total catch in 1961 and 33 percent in 1960. Larger cutthroat (8-14 inches) were more numerous in 1960 than in 1961. Large brook trout (8-12 inches) were more numerous in 1961 than in 1960.

The total number of fish per mile of stream and the number of catchable-size trout (7" or longer) per mile for the stream above the water intake is presented in Table 2. The data are given for 1960 and 1961.

Table 2. Total number of fish and number of catchable-size fish per mile of stream above water intake, O'Brien Creek, 1960 and 1961

	Brook trout		Cutthroat trout		TOTAL	
	1960	1961	1960	1961	1960	1961
Total---catchables	457-49	784-119	372-159	449-106	829-208	1233-225
Percent catchables	11%	15%	43%	24%	25%	18%

These data show changes occurring between years for the number of trout. The number of brook trout per mile of stream increased from 457 in 1960 to 784 in 1961; an increase of 72 percent. The number of catchable-sized brook trout rose from 49 in 1960 to 119 in 1961; an increase of 143 percent. Brook trout in the 4 to 6-inch size group were the most numerous fish in the 1960 sample. Growth data for brook trout from this stream indicates that the 4 to 6-inch fish of 1960 would enter into the catchable size group in 1961. Figure 2 also shows that most of the catchable-size brook trout collected in 1961 were in the 6 to 8 and 8-to 10-inch brackets.

The number of cutthroat trout rose from 372 to 449 per mile in 1961; an increase of 21 percent. The numbers of catchable-sized cutthroat fell from 159 in 1960 to 106 in 1961; a decrease of 33 percent. Figure 2 shows a marked decrease in 8 to 10-inch and 12 to 14-inch cutthroat in 1961.

The total population of both species rose from 829 in 1960 to 1233 in 1961; an increase of 49 percent. The number of catchable-size fish rose from 208 in 1960 to 225 in 1961; an increase of 8 percent. The large increase in total numbers of fish per mile of stream is due mainly to the increased numbers of brook trout. The increase in catchable-size trout is due to an increase in brook trout overcompensating a decrease in catchable-size cutthroat trout. Less of the total population per mile are catchable-size fish in 1961 and in 1960. This points out that the increased number of fish per mile is due to larger numbers of fish less than seven inches in length.

A comparison of the data collected from stations 2-7 to station 1 may show

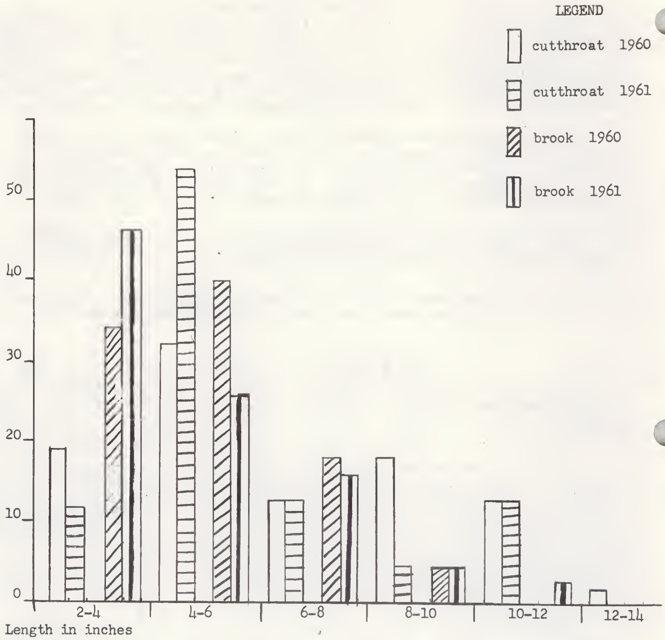

Figure 2. Length-frequency distribution (percent of total catch) of brook and cutthroat from O'Brien Creek in 1960 and 1961.

differences between an unfished and fished stream. A comparison of fish lengths between these sections is given in Table 3. These data show that the unfished portion of O'Brien Creek contains a greater percentage of fish less than six inches than over six inches. The fished portion of O'Brien Creek contained an equal percentage of fish less than six inches, and fish longer than six inches. None of the fish in the fished portion of the creek were longer than 10 inches, while some fish in the unfished portion exceeded 12 inches in total length.

Table 3. Comparison of fish lengths from Section 1 and Section 2-7, Brook trout and cutthroat trout, O'Brien Creek, 1960 and 1961 data combined.

	PERCENT OF CATCH IN SIZE GROUP			
Section(s)	0-3 inches	3-6 inches	6-9 inches	9-14 inches
1	8%	42%	46%	4%
2-7	11	60	20	9

Findings: O'Brien Creek Creel Census

If the fish population figures for O'Brien Creek survey are valid and the population undergoes no great change in the 1962 fishing season, brook trout should contribute about the same number of fish to the anglers' creel as the cutthroat. Creel Census information was collected on four Sundays during the 1962 angling season covered by this report, May 21-June 30. Information collected from each fisherman included the following: hours of angling effort, catch by species, length of each fish, type of lure; sex, age, and place of residence of the angler.

A summary of the census information is given in Table 4.

Table 4. Angler success, O'Brien Creek, May 21-June 30

No. anglers	Cutthroat	Aver. Size	Brook	Aver. Size	C.P.M.H.
57	133	8"	28	7"	1.03

* Catch-Per-Man-Hour

These data show that good angling success was experienced by people fishing O'Brien Creek. Fly fishermen were over twice as successful as bait or "hardware" anglers. The average size of the trout caught was small, but many fishermen caught their limit. The cutthroat trout made up 85 percent of the catch and brook trout 15 percent.

The catch data show that the cutthroat contributed the greatest number of fish to the creel although cutthroat and brook trout contribute equally to the catchable population. Whether the differentiated catch will continue throughout the remainder of the 1962 fishing season remains to be seen. Whether it will greatly affect either the cutthroat or brook trout population will be the objective of additional population studies.

Techniques Used: Flower Creek

No work was done on Flower Creek during this report period. Road construction by the U. S. Forest Service during the time of the planned survey prevented the fisheries crew from reaching the sampling sites with vehicle and equipment. It is recommended that this stream be resurveyed in the fall of 1962.

Techniques Used: Rattlesnake Creek

Rattlesnake Creek, Missoula's water supply source, was sampled once during the report period; in August 1961. The winter sampling scheduled for March 1962 was cancelled because of adverse snow and road conditions. The same sections were sampled in 1961 as were sampled in 1960. Figure 3 is a sketch map of Rattlesnake Creek showing the electrofishing sections and study areas.

Electrofishing procedures were the same as those used by Huston (1961) except pulsed D.C. electrofishing equipment (considered more efficient) was used in place of a 220-volt A.C. generator or 1000-volt D.C. generator used in former years. Data recorded included only the species, length and weight of each fish and the section from which taken.

Findings: Rattlesnake Creek

Area A (section 1) lies below the Montana Power dam and has been open to angling in the last few years. Species of fish found here include the cutthroat, brook, and rainbow trout, the Dolly Varden and sculpins (*Cottus* sp.) Area B and area C lie above the Montana Power dam and are in the area closed to angling. Species of fish found in area B are the same as those listed for area A. Species of fish found in area C were rainbow trout, cutthroat trout, and Dolly Varden. Brook trout and sculpins are not found in area C.

Only the presence or absence of the sculpins were noted for each area. No further mention will be made of this small bottom-living fish.

The average catch per section by area is presented in Table 5. Data are given for all sampling done since the inception of this study in February, 1960. The data given in Table 5 indicate that the trout population of Rattlesnake Creek is very dynamic and subject to change. Discussion of these changes will be limited generally to the two most important and numerous game species; the cutthroat and brook trout.

The data for area A show a somewhat stable population as far as total weight and numbers, but a flucuating population when the individual species are considered. The numbers and weight of the cutthroat and Dolly Varden were stable from 1960 to 1961, but the numbers of brook trout and rainbow trout varied considerably between years.

The flucuation in numbers between the various sampling times is apparent in all species of game fish found in area B. These data indicate that the Rattlesnake Creek trout population in area B "peaked out" in the summer of 1960, fell into a slump during the winter of 1960-61, is currently undergoing a recovery.

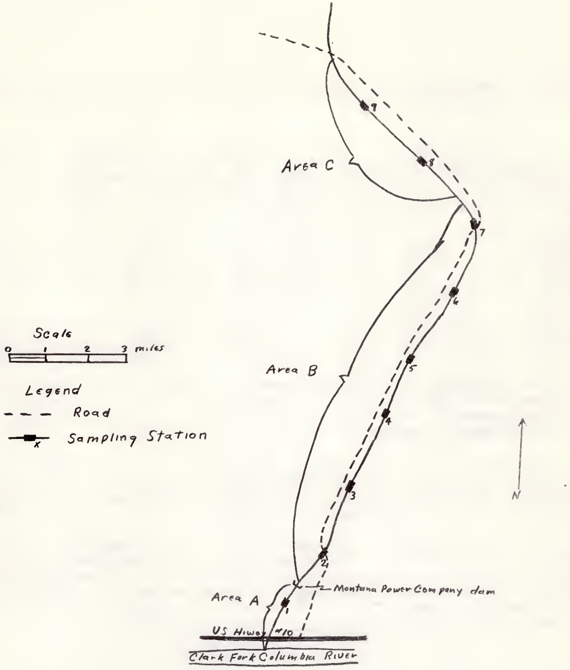

FIGURE 3. RATTLESNAKE CREEK AREAS AND ELECTROFISHING SECTIONS

Table 5. Average catch per section by area, date, and species, Rattlesnake Creek, 1960 and 1961

Date	Area	Cutthroat No.	Cutthroat Lbs.	Brook No.	Brook Lbs.	D. Varden No.	D. Varden Lbs.	Rainbow No.	Rainbow Lbs.	TOTAL No.	TOTAL Lbs.
Aug 60	A	8	0.81	12	0.63	4	0.21	6	0.39	30	2.04
Aug 61	A	9	0.60	6	0.50	6	0.23	17	1.35	37	2.68
Feb 60	B	18.3	7.54	12.5	1.48	3.8	1.11	1.5	0.39	36.1	10.51
Aug 60	B	28.5	8.91	17.3	1.57	7.7	1.75	5.2	1.31	58.7	13.54
Mar 61	B	15.8	3.93	8.5	0.66	5.0	0.49	2.5	0.26	31.8	5.34
Aug 61	B	21.0	4.81	10.8	1.21	4.8	0.65	4.0	0.35	40.6	7.02
Aug 60	C	23.0	4.92			14.5	2.39	2.0	0.28	39.5	7.59
Aug 61	C	27.5	2.83			25.5	2.45	5.5	1.04	58.5	6.32

The trout population of area C shows an increase in the numbers of fish of all species from 1960 to 1961. The average size of all species except the rainbow trout decreased. In 1961, even with an increase in numbers, the total weight of fish per section decreased.

Sections 2, 3, 4, and 7, area B, have been sampled at all sampling times. winter and summer. A length-frequency distribution for brook trout and cutthroat trout taken from these four sections is presented in Figures 3 and 4. This distribution is set up to correspond with the length and ages of the individual fish.

The brook trout distribution points out that fish larger than eight inches and of an age of four years or more have decreased in numbers throughout the length of the study. The 2- to 4- and 6- to 8-inch size classes have also decreased slightly in numbers throughout the study, but with large flucuations at various sampling times. The 4- to 6-inch class has shown a marked increase, but again with wide flucuations between the various sampling times.

Changes in the size and age group distribution of the cutthroat trout appears to be more consistant than for the brook trout. The first three size classes (0-9 inches) and age groups (I, II, and III) have all shown increased numbers with little flucuation during the course of the study. Size class's 9-12 (IV) and 12-15 (V) inches have shown marked declines during the course of the study. Size class 15-18 (VI) inches has remained stable throughout the study.

The length-frequencies of the cutthroat and brook trout point out that the decline in both numbers and weight of fish found between August 1960 and March 1961 was due to lesser numbers of the larger, older fish. The August 1961 data show that the increased numbers of fish at this time was made up of trout less than six inches in length.

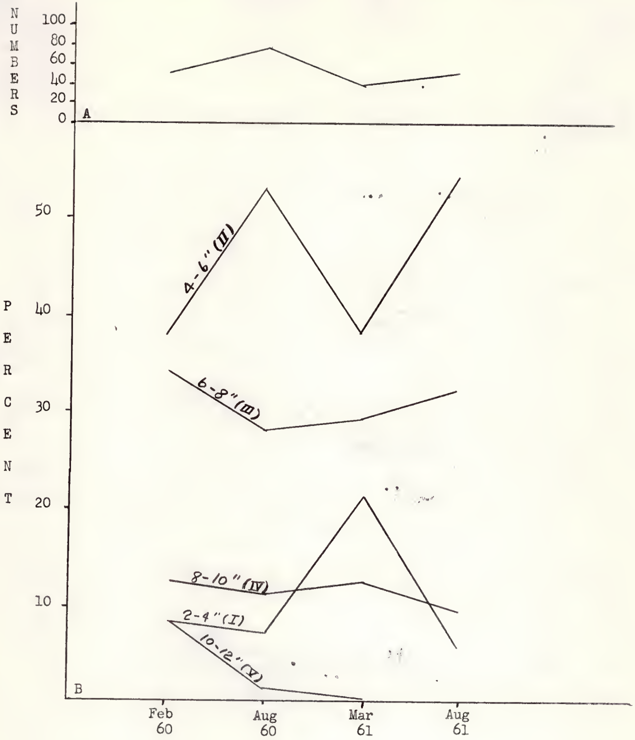

Figure 4. A--Total number of brook trout taken from sections 2,3,4, and 7, Rattlesnake Creek

B--Length-frequency distribution (percent of total) by length and age of brook trout taken from sections 2, 3, 4, and 7, Rattlesnake Creek

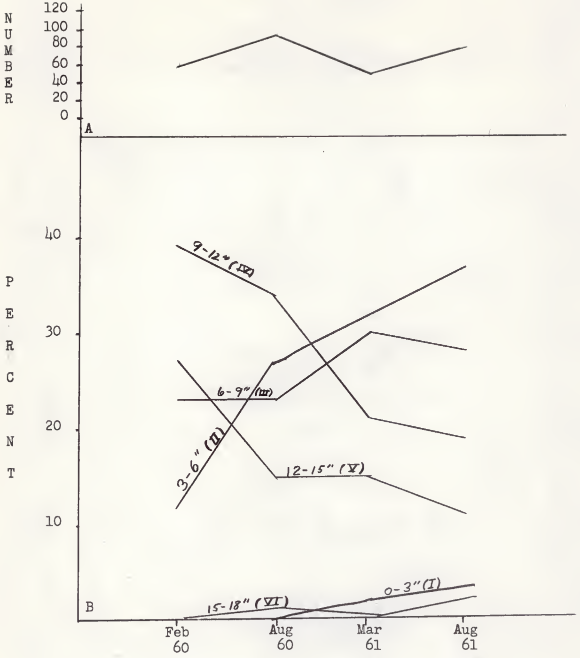

Figure 5. A--Total number of cutthroat taken from sections 2, 3, 4, and 7, Rattlesnake Creek

B--Length-frequency distribution (percent of total) by length and age of cutthroat taken from sections 2, 3, 4, and 7, Rattlesnake Creek

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Date December 6, 1962

Approved by George D. Holton

MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION

JOB COMPLETION REPORT

RESEARCH PROJECT SEGMENT

State of Montana

Project No.: F-12-R-8 Name Western Montana Fishery Study

Job No.: I Title Inventory of Waters of the Project Area

Period Covered: May 1, 1961 through April 30, 1962

Abstract:

Fourteen lakes and seven streams were surveyed during the project period. Thirteen of these waters were lakes or streams on which initial surveys were conducted. The remainder were waters on which follow-up survey information or specific information concerning management measures was desired. Management problems on Inez and Salmon Lakes, Silver Lake, Ninemile Creek and Clark Fork River are discussed and management recommendations are given for all waters surveyed.

Original survey data are filed in the district headquarters, and copies of permanent record lake and stream survey cards have been sent to Helena.

Recommendations:

1. Salmon Lake - Gill net sets should be repeated in 1962 as a means of evaluating the survival of the 53,986, 3-inch, rainbow trout which were planted in 1962. The plant and the gill net sets should be repeated for three years if fish are available.

2. Inez Lake - If a suitable barrier site can be found, this lake should be rehabilitated and replanted with west-slope cutthroat trout.

3. Silver and Diamond Lakes, Mineral County - These lakes should be planted as recommended in the F-12-R-7 report. Creel limits on brook trout should be reduced to 10 pounds and one fish, and the lakes should be surveyed again in 1963.

4. Middle Bowman Lake (Bowman Lake No. 2) - This lake should be re-surveyed in 1962, to determine changes in habitat and fish population coincident with the raising of a dam. The new construction was started in 1960 and will impound water for the first time in 1962.

5. Miller Creek - The section of this stream which is on state land should be opened to fishing. Two years after it is opened, the stream should be re-sampled.

6. Ninemile Creek - The study sections should be electro-fished as soon in 1962 as water levels permit, and again in August, 1962. The plant should be continued in 1962.

7. Flint Creek - To the present time the operation of the downstream-migrant, fry trap in this stream has been given a low priority. As a result the data have been sketchy and inconclusive. A concerted effort should be made in 1962 to install the trap before the migration begins and to continue its operation until the run is over. The late opening date on this stream should be continued.

8. Clark Fork River - The river section from Garrison to Rock Creek should be opened to fishing with the general season in 1962.

9. Lost Horse, Boulder and Twelvemile Creeks - No planting is recommended. Twelvemile Creek should be sampled again in 1962.

10. East Fork Reservoir - Plant with 36,600, 4-inch, rainbow trout in 1962.

11. Echo Lake - Continue the present plant in 1962 and 1963 and sample again in 1963.

12. Kaiser Lake - Investigate for permanency of public access. If access is suitable, rehabilitate and restock with 3,000, 2-inch rainbow trout.

13. Meadow Lake - Recommend that U.S.F.S. stabilize the beaver dam in the outlet to prevent washouts.

14. Moose Lake - No change in present management.

15. Silver Lake (Deerlodge County) - No change in present management.

16. Stony Lake - The Fish and Game Department should approve the U.S.F.S., dam-construction project on this lake and should cooperate on the project where possible.

17. Twin Lakes - No change in present management.

Objectives:

The primary objective of inventorying waters of the project area is to obtain basic information from waters on which no information concerning existing fish populations or the water's physical characteristics are presently available. These basic data are needed to determine management practices required to maintain, or provide, sustained yield fisheries in suitable waters.

In addition to surveying waters on which no information is presently available, more detailed surveys are frequently needed to plan or evaluate extensive management practices on specific waters. A brief description of the specific objective for each survey in this category is presented in conjunction with the findings from each survey.

Techniques Used:

Fourteen lakes and seven streams were surveyed by standard methods during the project period. Survey data were recorded on net set record forms, electric stream census forms, and/or field copies of Montana's standard lake and stream survey cards. Original data are in the district files and duplicates of permanent record lake and stream survey cards have been sent to Helena.

The following is a list of common names, abbreviations used, and scientific names used for all species mentioned in this report. Scientific and common names are those listed in the American Fisheries Society Special Publication No. 2, 1960.

Common Name	Abbreviation	Scientific Name
Kokanee	KOK	Oncorhynchus nerka (Walbaum)
Mountain whitefish	Wf	Prosopium williamsoni (Girard)
Cutthroat trout	Ct	Salmo clarki Richardson
Rainbow trout	Rb	Salmo gairdneri Richardson
Brown trout	LL	Salmo trutta Linnaeus
Brook trout	Eb	Salvelinus fontinalis Mitchill
Dolly Varden	Dv	Salvelinus malma (Walbaum)
Redside shiner	RSS	Richardsonius balteatus (Richardson)
Longnose sucker	F Su	Catostomus catostomus (Forster)
Largescale sucker	C Su Col.	Catostomus macrocheilus Girard
Sculpin	Cott	Cottus sp.
Northern Squawfish	SQ	Ptychocheilus oregonensis (Richardson)
Peamouth	CRC	Mylocheilus caurinus (Richardson)
Yellow Perch	YP	Perca flavescens (Mitchill)
Pumpkinseed	PS	Lepomis gibbosus (Linneaus)

All lengths of fishes in this report are presented as total lengths in inches.

Findings:

Salmon and Inez Lakes

These lakes are both known to contain mostly non-game fish. An experimental plant of 40,000, 2-inch, rainbow trout was made in Inez Lake in 1958 in an attempt to provide an economical "put and take" fishery. Because of the proximity and similar characteristics of Salmon Lake to Inez Lake, Salmon Lake was chosen as a control lake.

To evaluate the 1958 plant in Inez Lake, 20, overnight gill net sets were made in Salmon Lake and 15 sets in Inez Lake. Nets used were standard, 125 foot, experimental gill nets.

Scale samples and individual lengths and weights were taken from all game fish captured. Individual lengths and weights were taken from approximately 50 of each species of non-game fish and the remainder counted and weighed.

The game fish captured in 20 overnight gill net sets in Salmon Lake comprised 19.7 per cent of the 937 fish taken. Excluding whitefish, only 7.2 per cent of the total fish taken were game fish. Game fish in Inez Lake

comprised 12.4 per cent of the total fish taken, and excluding whitefish, only 1.9 per cent were game fish.

Catch data showing the per cent of total fish caught, by species and for both lakes, are presented in Table 1. Unfortunately, other work commitments prevented sampling of these lakes in 1959 or 1960. As a result, conclusive

Table 1. SUMMARIZATION OF SALMON AND INEZ LAKE POPULATION SURVEY.

Salmon Lake

Species	CSuCol	SQ	CRC	F Su	YP	PS	Wf	KOK	Dv	LL	Rb	Ct
No. caught	83	178	177	62	242	10	117	44	15	6	2	1
Ave.length	12.61	11.36	11.16	13.00	6.50	5.33	11.12	9.60	14.47	14.20	13.8	8.2
Ave.weight	.86	.52	.41	.73	.12	.14	.41	.33	.92	1.09	.87	.20
% of Total	8.86	19.00	18.89	6.62	25.83	1.07	12.49	4.70	1.60	.64	.21	.11

Inez Lake

Species	CSuCol	SQ	CRC	F Su	YP	PS	Wf	KOK	Dv	LL	Rb	Ct
No. caught	72	240	17	20	306	3	79	3	6	--	--	5
Ave.length	12.46	11.38	12.58	13.84	6.64	5.2	10.79	11.06	13.40	--	--	14.46
Ave.weight	.75	.49	.78	.94	.13	.17	.38	.49	.88	--	--	1.06
% of Total	9.59	31.96	2.26	2.66	40.74	.40	10.52	.40	.80	--	--	.66

data pertaining to the survival of the 1958 plant of 40,000 rainbow trout during these years are lacking. No rainbows were taken by gill netting in 1961, none were recorded in warden creel census during 1959, and four Inez Lake home owners who were interviewed during the survey reported no rainbow caught. Thus, if the 1958 plant did provide any fishing, it was a small amount and was short-lived.

In 1961, 53,986, 3-inch, rainbow trout were planted in Salmon Lake. The lake should be netted again in 1962 to evaluate this plant.

None of the various types of planting which have been used in Inez Lake since 1954 have significantly increased the game fish population of that lake (See the completion report for Job No. I, F-12-R-4). If a suitable barrier site can be found between Inez and Seeley Lakes, a barrier should be constructed and Inez and Alva Lakes should be rehabilitated and replanted with west-slope, cutthroat trout.

Age and growth data for game fish captured are presented in Appendix B.

Silver Lake (Mineral County)

Silver Lake was surveyed in 1955 and found to contain a population composed solely of brook trout, which averaged 8.5 inches. The catch limit was liberalized in 1956 in an attempt to direct more fishing pressure to the lake to increase the harvest. In 1958, the lake was again gill netted and the average size of the brook trout was 8.1 inches.

To further investigate the effects of the "no-limit" regulations, two experimental gill nets were fished overnight to obtain comparative data. Scales, lengths and weights were taken from all fish captured.

Brook trout were again the only species of fish taken from this lake. Age and growth data obtained from scale samples are presented in Appendix B.

Like several other brook trout lakes in Mineral County (see Completion Report for Job No. I, F-12-R-7) the growth rate of brook trout in Silver Lake is as good as or better than that of other trout species in similar mountain lakes. These fish are not stunted, instead their small size is due to some factor which prevents them from living over three years. Thus an increased harvest might be expected to have little or no effect on increasing the size of the fish. This is indicated by the data in Table 2, which show the catch per net and the average length and weight of brook trout taken in 1955, 58 and 61. From the steady drop in catch per net, as well as in average length and weight, it appears that the liberal regulations on Silver Lake have re-

duced numbers of fish without increasing their average size. Silver Lake has had liberalized creel limits for brook trout since 1956. In 1956 and 57 the limit was 10 pounds and 1 fish, since 1958 there has been no limit.

As recommended in the completion report for Job No. I, F-12-R-7, Silver Lake should be planted with 7-inch rainbow trout. The creel limit for brook trout should be 10 pounds and 1 fish, and the lake should be surveyed again in 1963.

Table 2. AVERAGE LENGTHS AND WEIGHTS OF BROOK TROUT, SILVER LAKE, 1955,58,61.

Year	No. in Sample	Ave. Length in inches	Ave. weight in pounds	Catch/net
1955	39	8.50	---	39
1958	91	8.12	0.18	23
1961	28	8.02	0.16	14

Middle Bowman Lake (#2)

This lake was surveyed initially in 1960. While the lake is on U.S.F.S. land, a private individual has obtained a special use permit for the lake and plans to raise the water level several feet by increasing the height of the dam which forms the lake.

To evaluate the effect on the fishery by the increased water level and subsequent water level fluctuations, five, overnight gill net sets were made to obtain data concerning the fish population prior to the alteration planned. These sets will be repeated following dam construction to obtain comparable data. Fish captured were weighed and measured, and scale samples taken.

In 1960, the rate of growth for rainbow trout in Bowman Lake was slower than that of cutthroat. At annulus I, cutthroat trout averaged 2.7 inches and rainbow trout averaged 2.1 inches. At annulus IV, cutthroat trout averaged 10.8 inches and rainbow trout averaged 8.5 inches. In 1961, growth rates between the two species were similar, with the exception of growth to annulus I (Appendix B.).

The average length of both species increased slightly from 1960 to 1961, while the average number of cutthroat captured per net decreased and the average number of rainbow captured per net increased (Table 3.).

Table 3. CATCH DATA FROM MIDDLE BOWMAN LAKE, 1960-61.

Species	Ave. catch per net 60	61	No. of fish captured 60	61	Ave. length (inches) 60	61
Ct	9.3	5.2	93	26	9.2	9.9
Rb	1.7	2.2	17	11	10.0	10.2

In 1960, construction on an impoundment dam on upper Bowman Lake was in progress, but at the time of survey had had no apparent effect on Middle Bowman Lake. In 1961, the dam on Upper Bowman Lake was completed and work on the dam on Middle Bowman had been initiated. This dam should impound water for the first time in 1962. At the time of survey in 1961, storage water was being released from Upper Bowman through Middle Bowman for irrigation purposes, and the lake was more turbid than normal.

This lake should be surveyed again in 1962.

Miller Creek

This stream has been closed to fishing since 1953 because of private land ownership problems. In 1959, two, 300 foot sections of the stream were electro-fished to obtain data on an unexploited, mixed population of cutthroat and brook trout. These sections were again electro-fished in 1961 as a continuation of the study. Periodic sampling of these stations will continue.

Numbers of trout collected during the 1961 sampling of Miller Creek were much lower than in 1959 (Table 4.). The average length of the trout remained about the same. Since Miller Creek is used for irrigation purposes, the

reduction in numbers is probably due to increased dewatering of the stream during the severely dry summer of 1961.

Table 4. NUMBERS AND AVERAGE LENGTHS OF BROOK TROUT AND CUTTHROAT TROUT CAPTURED FROM TWO SECTIONS OF MILLER CREEK, 1959 and 1961.

	1959		1961	
Species	No. in Sample	Average Length	No. in Sample	Average Length
Eb	130	4.18	48	3.96
Ct	54	6.20	22	6.55

Age and growth data from fish captured in 1961 are presented in Appendix B.

The portion of Miller Creek on state land should be open to fishing. Two years after it is opened, the stream should be re-sampled.

Ninemile Creek

Three, 300 foot, sections were again electro-fished following recommendations made in the 1959 completion report for an annual plant of 2,000 fingerling cutthroat trout. After survey in 1959, it was concluded that spawning success had been seriously impaired by previous dredge mining operations on this stream and that planting was necessary to sustain the fishery. Following three years of planting and fish population sampling, an evaluation of the success of these plants will be made.

The identical sections that were sampled in 1959 and 1960 were again electro-fished. All fish captured were weighed and measured and recorded by species.

Numbers of fish, by species, captured by electro-fishing the same sections in 1959, 60, and 61, are presented in Table 5. The stream was planted with 3,053, two to three-inch cutthroat trout on July 13, 1961, in the same general area in which the three study sections are located. These sections were sampled on Aug. 7, 1961, approximately the same length of time following the plant as in 1960.

Totals for all species captured did not change appreciably from totals obtained in 1960. A significant increase in numbers of fish in the 2.0 to 3.9 inch range occurred for cutthroat (Table 6.), but the number of fish in catchable sized categories decreased.

The data for evaluating management procedures on this stream are at present inconclusive. Data concerning the existing fish population immediately prior to the opening of the general fishing season would be an asset for evaluation. The study sections should be electro-fished as soon in 1962 as water levels permit, and again in August, 1962. The experimental plant should be continued in 1962.

Table 5. NUMBERS OF FISH, BY SPECIES AND SECTION, COLLECTED DURING SAMPLING ON NINEMILE CREEK, 1959-61.

	Section									Totals		
	1			2			3					
Species	59	60	61	59	60	61	59	60	61	59	60	61
Ct	20	49	48	9	46	33	20	33	55	49	128	136
Eb	6	20	4	4	3	14	4	8	7	14	31	25
Dv	0	0	1	0	0	0	1	6	3	1	6	4
Rb	0	0	0	0	0	1	0	0	0	0	0	1
Wf	13	10	5	1	7	18	0	0	0	14	17	23
F Su	0	3	3	0	0	0	0	0	0	0	3	3
Cott	30	27	--*	2	6	--	5	5	--	37	38	--

*Cottus not collected

Table 6. NUMBERS OF CUTTHROAT TROUT, BY 2-INCH LENGTH INTERVALS, COLLECTED FROM NINEMILE CREEK SHOCKING SECTIONS, 1959-61.

Length Intervals	Numbers of fish		
	1959	1960	1961
2.0 - 3.9"	19	40	71
4.0 - 5.9"	18	59	55
6.0 - 7.9"	11	19	9
8.0 - 9.9"	1	7	0
10.0 - 11.9"	0	1	0
12.0 - 13.9"	0	2	1
Totals	49	128	136

Clark Fork River

Five sections in the upper reaches of Clark Fork were electro-fished as a continuation of a population study designed to evaluate the effects of a serious pollution of the river in 1960 by industrial wastes.

A 230-volt, D.C., Homelite generator with a 2-negative, 1-positive electrode system was used for sampling. Section locations were identical to comparable sections fished in 1960. Standard block nets were used to delineate 300 foot sections. Scales, lengths, and weights were taken from all species of game fish captured and non-game fish were counted and recorded.

A summary of catch data obtained by electro-fishing five sections of the Clark Fork River is presented in Table 7. Sections 1, 3, and 6 are located in a portion of the river which at this time is classified as an "industrial" stream and is not subject to fisheries management. These three sections were not affected by the special closure to fishing. Sections 9 and 10 were included in the area which was closed to allow indigenous fish populations to reproduce and repopulate the river through natural means. Reports of pollution of the "industrial" section of the river are still received periodically.

Since 1960, numbers of game fish under 10 inches in length have increased 272 per cent, game fish over 10 inches have increased 633 per cent and non-game fish have increased by 1,476 per cent. The majority of the increase in non-game fish was composed of redside shiners and longnosed suckers smaller than 10 inches.

Game fish populations are apparently recovering from the severe fish-kill in 1960. The river from Garrison to Rock Creek should be opened to fishing with the general season in 1962.

Table 7. SUMMARY OF CATCH FROM FIVE SECTIONS OF CLARK FORK RIVER, 1960-61.

Section No.	LL				Eb				Ct				Wf				Non-game fish	
	Over 10"		Under 10"		Over 10"		Under 10"		Over 10"		Under 10"		Over 10"		Under 10"		All	
	60	61	60	61	60	61	60	61	60	61	60	61	60	61	60	61	60	61
1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40
6	0	3	0	0	0	0	1	4	0	0	0	0	0	0	0	0	0	17
9	2	9	0	8	0	0	0	0	0	0	0	0	0	1	2	1	20	255
10	0	5	4	18	0	0	0	0	1	4	2	6	0	0	0	4	1	19
Total Number	2	17	6	26	0	0	1	4	1	4	2	6	0	1	2	5	21	331
Average length	15.8	12.7	8.1	7.3	0	0	9.4	8.8	10.4	12.4	5.4	7.6	0	11.7	8.0	8.8	--	--

Flint Creek

A down-migrant fry trap was installed in Flint Creek, above Georgetown Lake, on July 2, 1961. The trap is designed to capture fry from about one-half the width of the stream. During periods of operation, the trap was checked and cleaned each 24-hour period. Fry captured were counted and released.

Other work assignments prevented operation of the trap during the period of greatest migration. As a result, comparable data were not obtained. The results of this phase of the study are recorded in Appendix A, but are not discussed.

Lost Horse, Boulder, and Twelvemile Creeks

These streams were surveyed because fish plants had been requested for Boulder and Lost Horse Creeks and the U.S.F.S. has begun a habitat improvement project on Twelvemile Creek. Sections electro-fished were 300 feet in length and were blocked with standard block nets. Fish captured were weighed and measured, and scale samples were taken. Physical characteristics of the streams were recorded on stream survey forms. All streams contained suitable spawning areas and small-sized trout were taken in our samples.

Existing fish populations were sampled in two sections of Lost Horse Creek and Boulder Creek. Three sections were electro-fished in Twelvemile Creek. Two of the sections of Twelvemile Creek (Sections 1 and 2) included sites at which the U.S.F.S. is planning to construct stream improvement structures. The other section (Section 3) includes a completed structure installed in 1961 by the U.S.F.S. These sections will be re-sampled in subsequent years, in cooperation with the U.S.F.S., to evaluate the effectiveness of these habitat improvement structures.

Age and growth data obtained from fish collected from these three streams are recorded in Appendix B. Fish from Lost Horse and Twelvemile Creeks exhibit slow growth typical of sterile waters. The growth rate of fish in Boulder Creek is much better. Cutthroat attain the same length in two years in Boulder Creek that they do in three years in the other two streams.

Numbers of fish and the average lengths of fish captured in Twelvemile Creek are presented in Table 8. A greater number of fish were captured in Section 3 than in either of the other sections, which could indicate that the

Table 8. NUMBER AND AVERAGE LENGTH IN INCHES OF TROUT FROM THREE SECTIONS OF TWELVEMILE CREEK, 1961.

Section	Ct		Eb		Dv	
	No.	Ave. Length	No.	Ave. Length	No.	Ave. Length
1	18	5.3	8	4.4	-	--
2	25	4.1	2	9.1	-	--
3*	28	4.7	6	6.3	6	6.0

*Includes stream improvement structure.

improvement structure did provide habitat for a greater number of fish. These figures may be misleading however, because this section originally had better natural habitat.

The same sections should be sampled again in 1962.

Mountain Lakes

Ten mountain lakes were surveyed during this report period. Six of these lakes were accessible by conventional or four-wheel drive vehicle. Survey personnel were packed into Stony Lake in cooperation with the U.S.F.S., and into Meadow and the Twin Lakes, without recompense, by the White-Tail Ranch of Ovando, Montana.

The lakes were surveyed by standard mountain lake survey methods, with the exception that a Bendix Depth Recorder was used for sounding five of the lakes accessible by vehicle. Survey data were recorded on lake survey forms.

A list of the mountain lakes surveyed, including location, number of gill nets fished, and a summary of catch data, is presented in Table 9. Data are also included on this table for Silver Lake (Mineral County) and Middle Bowman Lake. These two mountain lakes were discussed earlier because theirs were follow-up surveys that concerned special problems. Age and growth data obtained from fish captured are included in Appendix B. A brief description of findings pertinent to each lake, and management recommendations, are given:

Diamond Lake - Brook trout from this lake, as in Silver Lake, have a good growth rate for a mountain lake habitat, but no fish over three years old were taken. Creel limits should be reduced to ten pounds and one fish for brook trout and the lake should be planted with 1,000, 4-inch, rainbow trout. This is part of the management study on brook trout lakes which was recommended in the F-12-R-7 report. Comparable gill net sets should be repeated in 1963.

East Fork Reservoir - A severe mortality of rainbow trout was reported and investigated in this reservoir during the summer of 1960. Specimens were obtained and sent to various laboratories to ascertain the causative agent, but no explanation for the kill could be found. The reservoir was replanted in 1961 and during that summer the reservoir was drawn down almost to the minimum level, which resulted in almost depleting fish stocks in the reservoir. At the time of survey, only brook and Dolly Varden trout were captured in gill nets.

The reservoir is on the planting program to receive 36,600, 4-inch, rainbow trout in 1962, in an attempt to re-establish a rainbow trout fishery.

Table 9. LIST OF HIGH MOUNTAIN LAKES SURVEYED, 1961.

Lake	Location	Size (Acres)	Over-night sets	Species Collected	Number Collected	Ave. length (inches)
Diamond	16N,28W,18 Mineral Co.	25 (est)	2	Eb	87	7.6
East Fork Reservoir	4N,14W,6 Granite Co.	323	7	Eb	5	10.0
				Dv	35	16.2
Echo	6N,13W,32 Granite Co.	101	6	Eb	14	9.0
				Ct	1	11.5
				Rb	42	8.6
				F Su	233	10.7
Kaiser	4N,15W,18 Granite Co.	11	2	Dv	1	21.5
				Ct	5	10.4
				F Su	113	10.3
Meadow	16N,9W,18 Lewis and Clark Co.	9	1	Rb	17	10.9
Moose	4N,16W,36 Granite Co.	16	3	Eb	3	8.6
				Dv	9	21.4
				Ct	1	10.5
				Rb	23	12.8
				F Su	53	9.4
Silver	5N,13W,21 Deerlodge Co.	305	7	Eb	1	9.8
				Dv	2	20.2
				Rb	2	9.4
				KOK	1	9.2
				F Su	308	9.0
Stony	6N,17W,16 Granite Co.	10	1	Ct	36	9.9
Twin (Lower)	16N,9W,6 Lewis and Clark Co.	10	1	Ct	7	11.1
Twin (Upper)	16N,9W,8 Lewis and Clark Co.	7	1	Ct	17	15.0
Silver	19N,31W,32 Mineral Co.	17 (est)	2	Eb	28	8.0
Bowman #2	7N,11W,31 Powell Co.	10 (est)	5	Ct	26	10.0
				Rb	11	10.2

Echo Lake - This one hundred acre lake is within two miles of Georgetown Lake and has opened in May with the general season for many years. During this time, Georgetown has had a special season which opened near the end of June. Georgetown will open with the general season in 1962. Because of high fishing pressure on Echo during the period between the general season and the Georgetown openings, Echo Lake has received a large plant of catchable-sized trout each year. Following a winter angling season on Echo Lake in 1959-60, complaints of poor fishing have increased.

Comparative catch data from surveys in 1955 and 1961 are presented in Table 10. The longnosed sucker population increased 33 per cent from 1955 to 1961. The average size of suckers captured increased by 1.8 inches. In addition to species recorded in Table 10, two brown trout and one

Table 10. SUMMARY OF CATCH DATA FROM ECHO LAKE, 1955 and 1961.

		Eb			Rb			F Su		
Year	Sets	No.	No./net	Ave.Lgt.	No.	No./net	Ave.Lgt.	No.	No./net	Ave.Lgt.
1955	6	6	1.0	8.8	74	12.3	8.9	78	13.0	8.9
1961	6	14	2.3	9.0	42	7.0	8.6	233	38.8	10.7

cutthroat were taken in 1955, and in 1961, one cutthroat was captured. Age and growth data are presented in Appendix B. Scale samples were not taken from rainbow trout captured in 1961, because all but three fish were planted only one month prior to survey.

These data indicate that Echo Lake's game fish population did not improve between 1955 and 1961, either in total or in comparison to rough fish. Therefore, the present rate of planting should be continued through 1963, even though Georgetown will now open with the general season. Echo Lake should be sampled again in 1963 to see if the expected decrease in early season pressure has had an effect on Echo Lake's trout population.

Kaiser - Survey data from this lake indicate that the present fish population is not providing a suitable fishery. Public access to this lake should be investigated and if found to be sufficient the lake should be rehabilitated and the beaver dam blocking the inlet stream should be removed. Cabin owner participation in keeping the inlet stream free should be solicited. Following rehabilitation, the lake should be replanted with 3,100, 2-inch, rainbow trout.

Meadow - Rainbow trout were the only species of fish collected during survey of this lake. The stream (Meadow Creek) which parallels the lake shore and which the lake outlet empties into, is known to contain cutthroat trout, however. Although the lake is only four feet deep, it apparently does not winter-kill severely. The lake may have a sufficient quantity of suitable spring water to carry it through periods of heavy snow cover.

A beaver dam impounds the water which forms the lake. This dam reportedly washed out four years prior to survey, and according to packers who frequent the area, the size of fish presently being caught is much smaller than normal. It has been recommended to the U.S.F.S. on whose land the lake is situated, that some form of stabilization be given the beaver dam to prevent a recurrence of the dam washout. It was also stressed in recommendations that the depth of the lake should not be increased during any dam manipulation.

Moose - Moose Lake is on the current planting program to receive 3,000, 2-inch, rainbow trout in 1962. Age and growth data show that these fish reach the average size of 8.4 inches at the time of the formation of the second annulus, which is an acceptable growth rate. No change is recommended in the present management of this lake.

Silver (Deerlodge County) - Silver Lake has been impounded to form a reservoir for the storage of industrial and municipal water supplies. The

lake is located within two miles of Georgetown Lake, which is managed extensively as a mixed rainbow and cutthroat trout fishery. Silver Lake is presently infested with a large population of longnosed suckers and contains relatively few game fish. Because of severe drawdowns, the proximity of a popular fishing lake, and the status of the present fish population, no change in management is recommended.

Stony Lake - An old, mine-water-supply dam on this lake is in poor condition and should be rebuilt or torn out. The dam is partially breached and does not impound water now. It does cause about a four-foot increase in water level during spring runoff. The U.S.F.S. has proposed rebuilding the dam for fish habitat improvement. This should increase productivity by eliminating the present four-foot fluctuation in water level and may increase overwinter survival by adding 10 feet to the lake's depth; therefore it is recommended that the Montana Fish and Game Department approve the U.S.F.S. project.

Survey data indicate that fish spawning areas are sufficient to maintain the fishery and that the age class composition of the population is satisfactory. All reports indicate that the lake is providing a sustained-yield fishery through natural means, therefore no planting is recommended.

Twin Lakes - Upper Twin Lake contains a population of relatively few large cutthroat trout, plus a small number of smaller cutthroat trout. Few of the large cutthroat are caught, but the lake provides an area of quality fishing for the angler who wishes to fish it. Lower Twin Lake has a population of smaller cutthroat, and because of the proximity of Lower to Upper Twin Lake, the two lakes provide fisheries for anglers who wish to try for a large fish, or those who desire to catch more, but smaller fish. For this reason, neither of the lakes require planting.

Prepared by Ralph W. Boland Approved by George D. Holton

Date May 15, 1962

Appendix A. NUMBERS OF FRY CAPTURED IN FLINT CREEK DOWNSTREAM-MIGRANT FRY TRAP, 1958, 60 AND 61.

	Numbers of Fry Captured						
Date	1958*	1960	1961	Date	1958*	1960	1961
July 2	--**	--	0	Aug. 1	139	--	--
3	--	--	0	2	181	7	--
4	--	--	0	3	380	9	--
5	--	--	0	4	--	11	--
6	--	--	0	5	--	0	--
7	--	--	0	6	--	0	0
8	--	--	0	7	114	1	0
9	--	--	0	8	--	0	0
10	--	--	0	9	--	1	0
11	--	--	0	10	--	1	0
12	--	--	0	11	--	1	0
13	--	--	0	12	10	4	0
14	--	100	35	13	27	1	0
15	--	158	9	14	--	0	0
16	--	161	--	15	--	0	0
17	--	351	--	16	20	0	0
18	--	41	--	17	--	0	0
19	--	700	--	18	--	0	0
20	--	313	0	19	25	0	--
21	--	131	--	20	--	0	--
22	--	10	--	21	--	0	--
23	--	22	--	22	--	0	--
24	--	45	--	23	--	1	--
25	60	26	--	24	--	0	--
26	--	--	--	25	--	0	--
27	27	--	--				
28	--	--	71				
29	--	--	12				
30	--	--	Molested				
31	--	--	31				

*Trap in operation for approximate 12 hours, overnight, periods in 1958.
In 1960 and 1961, trap operated for approximate 24 hr. periods.

**Dash designates trap not operated.

Appendix B. AGE AND GROWTH FOR ALL SPECIES, ALL WATERS SURVEYED*, 1961

Water	Sp.	Average Length in inches at annulus I	II	III	IV	V	VI
Streams:							
Boulder Cr.	Ct	3.5 (35)	6.3 (12)	9.9 (1)			
	Eb	2.2 (1)	5.6 (1)				
	LL	3.7 (1)	8.9 (1)				
	Dv	2.8 (34)	5.6 (17)				
Clark Fk. #6	Eb	3.5 (4)	6.5 (4)				
	LL	2.5 (3)	5.2 (3)	13.7 (1)			
Clark Fk. #9	LL	3.2 (15)	7.0 (11)	12.1 (1)			
Clark Fk. #10	LL	3.5 (19)	7.6 (8)	11.2 (2)			
	Ct	2.8 (10)	7.4 (5)	14.3 (1)			
	Wf	5.0 (4)					
Lost Horse Cr.	Ct	2.5 (11)	4.4 (9)	6.3 (4)	6.3 (1)		
	Eb	1.7 (3)	3.6 (3)				
	Dv	1.5 (1)	3.1 (1)				
Miller Cr.	Eb	3.1 (15)	6.3 (5)				
	Ct	3.0 (19)	5.0 (4)	7.4 (3)			
Twelvemile Cr.	Ct	2.4 (46)	4.6 (15)	6.2 (2)			
	Eb	2.9 (11)	5.0 (5)	7.4 (2)			
	Dv	2.3 (6)	4.2 (3)	6.4 (2)			
Lakes:							
Bowman (#2)	Ct	2.8 (24)	6.0 (26)	8.9 (25)			
	Rb	3.2 (11)	6.4 (11)	9.0 (9)	12.1 (2)		
Diamond	Eb	2.7 (75)	5.8 (75)	7.5 (11)			
Echo**	Eb	3.0 (13)	5.9 (13)	8.4 (3)	11.9 (1)	14.5 (1)	16.0 (1)
Inez	Ct	2.4 (5)	4.7 (5)	6.9 (5)	11.5 (5)	14.9 (3)	
	Dv	3.2 (6)	6.3 (6)	9.5 (5)	14.6 (1)		
	KOK	4.3 (2)	8.4 (2)	10.4 (2)			
	Wf	3.5 (25)	6.6 (25)	8.7 (23)	10.0 (18)	10.8 (7)	11.1 (1)
Kaiser	Ct	2.5 (5)	6.1 (5)	9.7 (5)			
	Dv	3.7 (1)	5.8 (1)	10.3 (1)	14.6 (1)	18.0 (1)	
Meadow	Rb	2.4 (17)	5.3 (17)	8.3 (14)	10.3 (7)	12.4 (4)	
Moose	Ct	3.6 (1)	5.5 (1)	9.4 (1)			
	Rb	2.3 (23)	8.4 (23)	12.1 (20)	14.9 (4)		
	Dv	2.8 (5)	5.8 (5)	9.7 (5)	14.0 (5)	19.3 (3)	23.4 (2)
	Eb	3.0 (3)	5.6 (3)	8.9 (1)			

Appendix B. (cont'd.)

Water	Sp.	I	II	III	IV	V	VI
		Average Length in inches at annulus					
Salmon	Ct	2.9 (1)	5.7 (1)				
	LL	2.9 (6)	5.4 (6)	8.8 (6)	11.7 (5)	14.1 (3)	15.8 (2)
	Rb	2.8 (2)	6.8 (2)	10.4 (2)	14.5 (1)		
	Dv	3.0 (15)	5.9 (15)	9.2 (14)	12.5 (10)	17.3 (1)	
	KOK	4.1 (16)	8.8 (6)				
	Wf	3.2 (33)	6.6 (32)	9.4 (29)	10.5 (15)	11.7 (7)	13.0 (3)
Silver (19N,31W,32)	Eb	2.8 (28)	6.0 (27)	7.4 (4)			
Silver (5N,13W,21)	Rb	2.6 (2)	7.1 (2)	10.4 (1)			
	Dv	2.8 (1)	5.5 (1)	9.7 (1)			
	KOK	4.3 (1)	8.4 (1)				
	Eb	2.0 (1)	3.7 (1)	6.4 (1)	8.5 (1)		
Stony	Ct	2.3 (14)	5.7 (14)	8.6 (14)	10.6 (9)	14.9 (1)	
Twin (Lower)	Ct	2.9 (7)	6.4 (7)	9.8 (6)	12.4 (2)		
Twin (Upper)	Ct	3.4 (16)	6.6 (12)	10.8 (11)	15.0 (11)	18.0 (5)	

*Age and growth data not obtained from Ninemile Creek, Flint Creek, or East Fork Reservoir.
**One fish reached 17.4 inches at annulus VII.

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#3

MONTANA DEPARTMENT OF FISH AND GAME
FEDERAL AID IN FISH RESTORATION SECTION
HELENA, MONTANA

JOB COMPLETION REPORT
INVESTIGATIONS PROJECTS

State of Montana

Name Western Montana Fishery Study

Project No. F-12-R-7

Title Investigation of the Effects of U.S. Forest Service Forest Insect Control Program on Aquatic Life

Job No. IV

Period Covered May 1, 1960 - April 30, 1961

Abstract:

The U. S. Forest Service did not carry out any of their tentatively planned spray projects in the western district in the period covered. Therefore, no work was done on this job. It is recommended that the same description for this job be repeated during the next project year.

Objectives:

The objectives of this study were to determine and measure some of the effects of large-scale forest spraying with DDT for insect control upon aquatic life. From the data gathered, recommendations may be drawn to better future spraying programs.

Techniques Used:

Liason with the forest insect control section of the U.S. Forest Service in the Missoula regional office has been carried out by phone conversations and meetings, throughout the period covered by this report.

Findings:

Budget cuts prohibited the U. S. Forest Service from carrying out all their planned DDT spray operations in 1960. The one proposed spray plan in this project area was dropped for the year. However, the reasons for the necessity of a control program in the Lincoln area still exist and the U.S. Forest Service now plans to carry out essentially the same control project in 1961, if money is available.

Recommendations:

The proposed DDT spray program for 1961 should be investigated as planned in 1960. The same job description should be carried over to next year's Western Fishery District P. S. & E.

Prepared by Arthur N. Whitney

Approved by George D. Holton

Date February 7, 1961

MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION
HELENA, MONTANA

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#3

JOB COMPLETION REPORT

INVESTIGATIONS PROJECT

State of Montana

Project No. F-12-R-7 Name Western Montana Fishery Study

Job No. III Title Georgetown Lake Creel Census

Period Covered March 1, 1960 - April 30, 1961

ABSTRACT

Creel census was conducted on Georgetown Lake during the special winter fishing season to obtain data for making estimates of total angler harvest and pressure. The estimate of total harvest was 49,200 game fish, and total pressure was 68,900 hours. The rate of success was 0.71 fish per hour. An estimated 77 per cent of the total harvest was comprised of cutthroat and rainbow trout planted as fingerlings.

RECOMMENDATIONS

It is recommended that Georgetown Lake be planted with 150,000 each, of rainbow and cutthroat fingerling trout in 1961. One-third of each species planted should be marked with a distinctive fin clip.

Because of the importance of Georgetown Lake to the area, creel census should be conducted during the 1961 summer season to further evaluate the fishery. Census should again be conducted during the special winter fishing season in 1962-63.

OBJECTIVES

The objective of the Georgetown Lake winter creel census was to obtain data for making estimates of total fishing pressure and harvest. This information will be used in an evaluation of the effect of the special winter fishing season on the Georgetown Lake fishery.

TECHNIQUES USED

The winter fishing season on Georgetown Lake opened on December 11, 1960 and continued for 27 Saturdays, Sundays and legal holidays until February 26, 1961. Creel census was conducted on each day of the season.

Two series of data were obtained each day of the season: (1) individual angler contacts, and (2) total counts of angler cars during daylight hours

and counts of lights on the lake during hours of darkness.

To effectively census this 3,000 acre lake, the lake was divided into three areas and each day into six time periods. The area in which contacts were to be made were chosen in a systematic random manner, and the time periods for contacting anglers were sequential following initial random selection of time periods.

Counts of angler cars, both on shore and on the ice, and/or light counts on the ice, were made four times each day, with the exception of Christmas and New Years, when only two counts were made each day. The total number of of counts was 104. The relationship between the number of anglers and the number of lights used was determined by subsampling.

Only completed trip angler contacts were recorded. In addition to standard creel census contact data, the angler's automobile license number, and the fin clip code number of planted fish were included. In 1960, 150,000 each of cutthroat and rainbow trout fingerlings were planted. One-third of each species were marked by removal of the adipose fin. Fish planted in 1958 and 1959 had also been marked by distinctive clips in the same ratio.

FINDINGS

The analysis of data to determine total pressure and harvest involves the following steps: (1) determining the relationship between light and car counts and the number of anglers, (2) computing pressure, rate of success, harvest and the number of anglers, and (3) determing the precision of these estimates.

Pressure and Harvest

Sampling to determine the number of anglers per light was accomplished by making individual counts of the number of anglers per light at various times throughout the season. A check on 183 lights revealed that 382 anglers were using these lights, for an average of 2.09 anglers per light.

A subsample of 100 cars showed a mean number of anglers of 2.23.

To determine the total pressure in terms of hours fished, the average number of fishermen per count is multiplied by the total possible fishing hours in the season (459). The average number of fishermen per count is estimated by adding:

(a) The number of lights counted times the average number of anglers per light, or

$$(1,370)(2.09) = 2,863 \text{ anglers estimated}$$

(b) The number of cars counted on shore or ice, times the average number of anglers per car, or

$$(5,714)(2.23) = 12,742 \text{ anglers estimated}$$

$$\text{TOTAL} = 15,605 \text{ anglers estimated}$$

The above total of 15,605 anglers is an estimate of the total number of anglers present during 104 car and light counts. Since the average time between counts was greater than the average length of fisherman day, it is not an estimate of the total number of fishing trips made during the winter season. It was derived solely for the purpose of determining the average number of anglers per count.

$$\frac{15,605}{104} = 150.05 \text{ anglers per count}$$

Therefore the estimated total pressure is:

$$(150.05)\ (459) = 68,873 \text{ fisherman hours.}$$

Total angler trips for the season are computed by dividing the total fisherman hours by the average length of trip. Average length of trip was 4.494 hours and was derived from angler contacts.

$$\frac{68,873}{4.494} = 15,326 \text{ angler trips}$$

$$R = \frac{F}{H} = \frac{3.209}{4.494} = 0.714 \text{ fish per hour}$$

where R equals rate of success, F equals mean number of fish per fisherman and H equals mean length of trip. A total of 2,813 anglers were contacted. They fished for 12,641 hours and caught 9,027 fish.

The total harvest is calculated by multiplying the rate of success by the total hours fished, or:

$$(0.714)\ (68,873) = 49,175 \text{ fish harvested}$$

Precision of Estimates

The data collected in this study were from parties (lights and cars) and individuals. The precision of estimates based upon subsamples is based upon group and individual variances. This differs from the preceding analysis that was made to give a series of point estimates.

All fiducial intervals were calculated at the 95 per cent confidence level.

Total Hours

The fiducial intervals for total hours of fisherman pressure are computed from the counts of lights and cars as follows:

The interval was calculated using subsample data to determine anglers per light. The standard errors of lights (x) counted and anglers (y) counted

are combined by:

$$S_{\bar{x}} = \left(\frac{S_{\bar{x}}}{\bar{x}}\right)^2 + \left(\frac{S_{\bar{y}}}{\bar{y}}\right)^2 = \left(\frac{3.605}{16.61}\right)^2 + \left(\frac{1.414}{7.96}\right)^2$$

$$= 0.471 + 0.0315$$

$$= 0.0786$$

The fiducial interval for the number of anglers estimated by light counts at the 95 per cent level of confidence is then:

$$\text{C. L. } .95 = (1370)(2.09) + (2.07)(.0786)(1370)$$

$$= 2{,}863 \pm 223\text{, or}$$

Lower Limit	Point Estimate	Upper Limit
2,640	2,863	3,086

(b) The interval for the number of anglers from cars counted on shore was calculated from the following angler/car subsample data, where X equals the number of anglers counted:

$$\Sigma X_2 = 223$$

$$\Sigma X_2 = 575$$

$$\Sigma x = 78$$

$$\bar{x} = 2.23$$

$$S_{\bar{x}} = 0.0887$$

$$N = 100$$

Standard errors are not combined in this instance because the variance is in the number of fisherman per single car observed. The fiducial interval at the 95 per cent level of confidence is then:

$$\text{C. L. } .95 = (5714)(2.23) \pm (1.96)(0.0887)(5714)$$

$$= 12{,}742 \pm 993 \text{ or}$$

Lower Limit	Point Estimate	Upper Limit
11,749	12,742	13,735

To obtain an estimate of total anglers counted with fiducial interval at

the 95 per cent level of confidence, point estimates and limits are added as:

(a)	2,640	2,863	3,086
(b)	11,749	12,742	13,735
	14,389	15,605	16,821

The confidence limits of hours fished and the number of fish harvested were computed by dividing the total point estimate and the associated limits of the number of anglers counted by the number of counts (104), which is 138.36 (lower), 150.05 (point), and 161.74 (upper). Each result is then multiplied by the total possible fishing hours in the season (459) to expand the estimate to the season's hours fished, which are:

Hours Lower Limit	Hours Point Estimate	Hours Upper Limit
63,507	68,873	74,239

Rate of Success

Similarly the rate of success is calculated from the subsample angler parties. The standard error for rate of success for a party is:

$$S_{\bar{x}} = \left(\frac{S_{\bar{x}1}}{\bar{x}_1}\right)^2 + \left(\frac{S_{\bar{x}2}}{\bar{x}_2}\right)^2$$

$$\frac{3.21}{49.77} + \frac{3.14}{37.92}$$

$$.0644 + 0828 = 0.1472 = S_{\bar{x}} \text{ Rate of Success}$$

Confidence intervals then are:

$$0.71 \pm 1.96\ (0.1472)$$

$$= 0.71 \pm 0.29$$

Then:

Lower	Point	Upper
0.42	0.71	1.00

Total Harvest

Total harvest was estimated by the product of the estimated rate of catch and estimated total hours fished. Therefore, the standard error

for total harvest is:

$$S_{\bar{x}} = \frac{S_{\bar{x}} \text{ (Rate of Success) } S_{\bar{x}} \text{ (Total hours)}}{\bar{x} \text{ (Rate of Success) } \bar{x} \text{ (Total hours)}}$$

$$= \frac{(0.1472)(3.21)}{(0.714)(49.77)} = 0.0133$$

Using normal confidence intervals with a t value of 1.96 the following expanded estimate of harvest with 95 per cent confidence limits may be computed:

$$C.\ I. = (68{,}873)(0.714) \pm (68{,}873)(0.714)(1.96)(0.0133)$$

$$49{,}175 \pm 1282$$

Therefore:

Lower Estimate	Total Harvest Point Estimate	Upper Estimate
47,893	49,175	50,457

Species Composition

The species composition of the recorded catch is presented in Table 1.

Table 1. SPECIES COMPOSITION OF RECORDED CATCH, GEORGETOWN LAKE. 1960-61.

		Number	Per cent of Total Fish Caught
Cutthroat trout	1958*	88	1.0
	1959	1,031	11.4
	1960	99	1.1
Total Marked		1,218	
Unmarked		2,695	29.8
Total Cutthroat		3,913	
Rainbow trout	1958*	130	1.4
	1959	1,067	11.8
	1960	4	0.1
Total Marked		1,197	
Unmarked		2,113	23.4
Total Rainbow		3,310	
Eastern brook trout		300	3.3
Grayling		14	0.2
Kokanee salmon		1,486	16.5
Total Fish Caught		9,027	100.0

*Year of Plant

On the basis of one-third of planted trout being marked, an estimated 3,654 (1,218 marked cutthroat X 3 = 3,654) of the cutthroat trout caught were planted fish. This is 93.4 per cent of the 3,913 cutthroat trout recorded. On the same basis, an estimated 3,603 marked rainbow were caught. This number is higher than the number checked, so it is concluded that all rainbow trout were planted fish.

Of the 9,027 fish recorded during the special winter fishing season, 6,968 or 77.2 per cent were hatchery cutthroat and rainbow trout which had been planted as fingerlings.

Prepared by R. W. Boland Approved by George D. Holton

Date December 1962

MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION
HELENA, MONTANA

JOB COMPLETION REPORT
INVESTIGATIONS PROJECT

State of Montana

Project No. F-12-R-7 Name Western Montana Fishery Study

Job No. II Title Population Survey of Rattlesnake Creek, Flower Creek, and O'Brien Creek

Period Covered May 1, 1960 - April 30, 1961

Abstract:

Rattlesnake Creek was surveyed by electro-fishing twice, and Flower Creek and O'Brien Creek were surveyed once during the report period. Results of these surveys, in addition to age and growth data, are presented in tabular form. Recommendations for the continuation of this study are presented.

Objectives:

Rattlesnake Creek, Flower Creek and O'Brien Creek are respectively sources of domestic water for the towns of Missoula, Libby and Troy, Montana. As such, these streams have been closed to angling above the water intakes for at least the past twenty years. It has been assumed from this fact that these three streams should represent a stream fishery in a near "virgin" condition.

Long-term objectives of this study include sampling of the stream populations in their present state for several years. After this information has been gathered, it is planned that the streams will be opened to angling. The effects of harvesting upon the fish populations along with harvest data will be collected. These data should help to give an insight into the proper management of game species for sport fishing. Of special interest are the problems conductive to the management of a cutthroat trout (Salmo clarki) fishery.

Objectives during the report period were to start the population sampling under the closed-to-angling situation. Data were collected concerning population levels, species composition, age and growth structure of the populations, and some physical and chemical factors of the environments.

Techniques Used:

Rattlesnake Creek is a tributary of the Clark Fork of the Columbia River and joins this river on the eastern outskirts of Missoula, Montana.

Rattlesnake Creek, above the Montana Power Company's dam (domestic water intake), has been closed to fishing for many years. The stream below this dam has at times been closed to fishing, open for children only, and is now open to general fishing.

The fish population of this stream was sampled twice during the report period; once during August and once during March. A 300-foot sampling section was picked about every two miles along the accessible parts of the stream. Eight sections were selected above the domestic water intake and one section was selected below this water intake. All of these sections were sampled during August, while, due to ice and snow, only four were sampled in March. Figure 1 shows the locations of the sampling sites.

For all sampling the following procedures were used: Each section was blocked off from the stream, above and below, by placing an electrical seine across the upper end and a block net across the lower end. For the winter-time sampling, a 220-volt a.c. shocker was used. In August, all sections except one were sampled by electro-fishing with a 1000-volt d.c. unit as the power source. The one section was electro-fished with the 220-volt a.c. unit, since it was impossible to get the d.c. unit into the stream bank.

Each section was worked until all or nearly all fish were captured. All fish were recorded by species, length, and weight. Scale samples from fish collected above the water intake were taken for age and growth analysis. No scales were taken from fish collected below the water intake. Fish scales were read and growth calculated by the project leader. Some stream flow measurements, temperatures, and one total dissolved solids sample were taken by project personnel.

Findings:

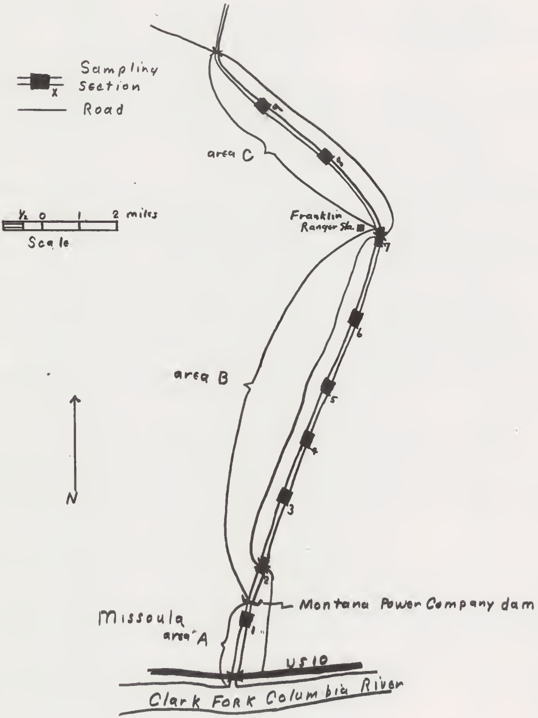
Rattlesnake Creek

For the presentation of data in this report, and for future studies, Rattlesnake Creek will be divided into three areas. Area A will include the stream below the Montana Power Company dam (open to angling and including section 1). Area B will include the portion of the stream from the Montana Power Company dam upstream to the Franklin Ranger Station (closed to fishing and including sections 2 through 7). Area C will include the stream above the Franklin Ranger Station to where the present road leaves the stream bottom (closed to angling and including sections 8 and 9).

Rattlesnake Creek above the Montana Power Company dam has an average flow of 35-40 c.f.s. with a range of from 20-150 cfs. Stream gradient averages about 80 feet of drop per mile. The stream has excellent cover and shade and the bottom is composed of mainly rubble and boulders; with very little sand and gravel. Total dissolved solids taken in April, 1960, was 13 p.p.m. Temperatures vary from the low 30's to the middle 60 degrees farenheit.

The flow of Rattlesnake Creek below the Montana Power dam varies with the water demand of Missoula. During periods of heavy water use, area A may only flow about 5 c.f.s. Maximum flows are over 100 c.f.s. The stream

Figure 1. Areas and sampling stations, Rattlesnake Creek, 1960-61.



gradient is considerably less than that of the upper areas. Some channel changes have been made on the lower mile where the stream flows through Missoula's suburbs. Fish habitat is generally poor, due to the extreme de-watering, some industrial pollution, and channel realignment.

Species of fish present in Rattlesnake Creek include the mountain whitefish (*Prosopium williamsoni*), rainbow trout (*Salmo gairdneri*), cutthroat trout (*Salmo clarki*), brook trout (*Salvelinus fontinalis*), Dolly Varden (*Salvelinus malma*), and sculpins (*Cottus* spp).

The cutthroat trout was the predominate game fish taken in areas B and C. In area B cutthroat were followed by brook trout, Dolly Varden, and rainbow trout followed cutthroat in abundance. In area A the brook trout was dominate, followed by the cutthroat, rainbow, Dolly Varden, and whitefish.

Sculpins were found in areas A and B, but not in C. These fish were very abundant in area A, but decreased in abundance in area B from section 2 through section 7. The sculpins are not considered in any of the following catch data. This fish's small size and bottom-dwelling habits make its capture difficult with our standard stream-sampling techniques. Thus, field notations of rough abundance estimates are more indicative of cottus populations than are numbers of these fish captured per section.

Nine 300-foot long sections were electro-fished in August, 1960. Four sections were electro-fished in March, 1961, and in February, 1960. The latter sampling does not fall into the report period, but will be included in this report. Both winter-time samplings covered the same four sections, while the August sampling covered these sections in addition to five others. The catch by area, by section, by date, and by species is given in Table 1.

Table 1. Catch by area, section, date and species - Rattlesnake Creek.

			Whitefish		Cutthroat		Brook		D. Varden		Rainbow	
Date	Area	Section	No.	Lb.	No.	Lb.	No.	Lb.	No.	Lb.	No.	Lb.
Aug. 1960	A	1	2	0.14	8	0.81	12	0.63	4	0.21	6	0.39
Feb. 1960	B	2			25	13.16	5	1.48	3	0.94	4	0.49
Aug. 1960	B	2			50	11.38	11	1.36	8	1.22	23	5.24
Mar. 1961	B	2			20	4.81	2	0.28	7	1.32	8	0.31
Feb. 1960	B	3			21	9.15	4	0.24	1	0.18	1	0.50
Aug. 1960	B	3			23	10.91	18	1.11	5	1.02	3	1.05
Mar. 1961	B	3			18	6.12	11	0.80	9	0.41	2	0.71
Feb. 1960	B	4			18	4.74	34	3.09	5	2.03	1	0.54
Aug. 1960	B	4			22	5.46	41	3.50	4	0.54	2	0.61
Mar. 1961	B	4			11	1.73	20	1.28	3	0.07		
Aug. 1960	B	5			48	15.57	13	1.01	12	4.95		
Aug. 1960	B	6			21	7.83	16	1.64	10	1.44		

Table 1 (Continued)

Date	Area	Section	Whitefish No.	Whitefish Lb.	Cutthroat No.	Cutthroat Lb.	Brook No.	Brook Lb.	D. Varden No.	D. Varden Lb.	Rainbow No.	Rainbow Lb.
Feb. 1960	B	7			9	3.10	7	1.12	6	1.30		
Aug. 1960	B	7			7	2.29	5	0.78	7	1.31	3	0.93
Mar. 1961	B	7			14	3.06	1	0.26	1	0.16		
Aug. 1960	C	8			14	4.25			21	2.41	1	0.25
Aug. 1960	C	9			32	5.58			8	2.37	3	0.31

The combined catch for sections 2, 3, 4, and 7 for each sampling period is given in Table 2. These data show that there were no great differences in the weight of trout (all species combined) taken between the February and August sampling, but that a very marked reduction was apparent from the August sampling to the March sampling. The total number of trout taken increased from the February to the August sampling, then decreased below the February level during the March sampling.

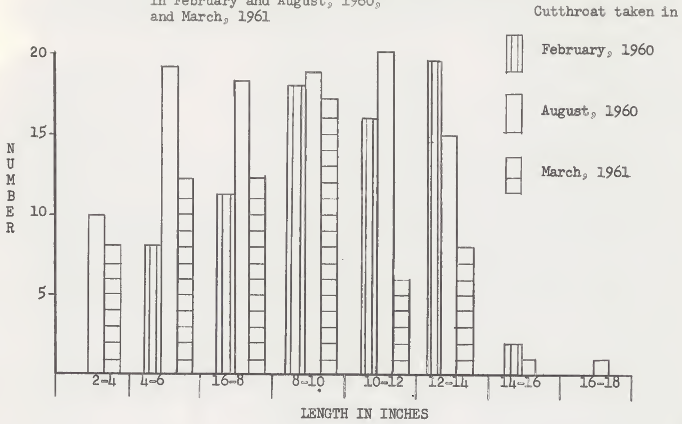
Table 2. Catch data for trout taken in sections 2, 3, 4, and 7, area B, February, 1960; August, 1960; and March, 1961.

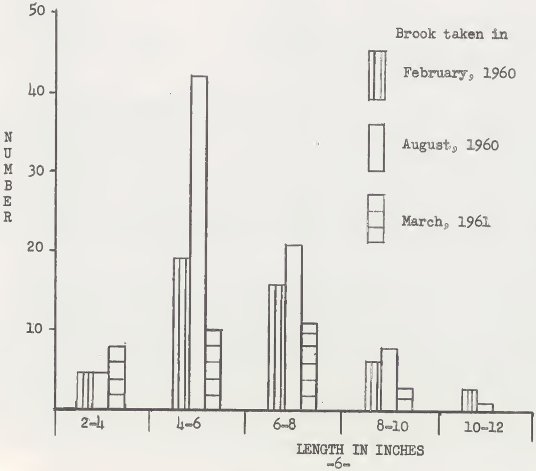
Date	Cutthroat No.	Cutthroat Lb.	Brook No.	Brook Lb.	D. Varden No.	D. Varden Lb.	Rainbow No.	Rainbow Lb.	Total No.	Total Lb.
Feb. 1960	73	30.15	50	5.93	15	4.45	6	1.53	144	42.06
Aug. 1960	102	30.04	75	6.75	24	4.09	31	7.83	232	48.71
Mar. 1961	63	15.72	34	2.62	20	1.96	10	1.02	127	21.32

The length-frequency of brook trout and cutthroat trout is given in Figure 2. From this figure it can be seen that the increase in numbers of fish from the February to the August sampling was due largely to an increase of fish less than eight inches in total length. Of note is the fact that no cutthroat less than four inches were taken in the February sampling. This increase in small trout may be, in part, due to the greater electrofishing efficiency of d.c. current, as compared to a.c. current. Another factor may be the greater availability of small fish during the summer and fall months. Both the brook and cutthroat trout reach the 4- to 6-inch class during their second and early third year of life (Table 5).

The comparison of the length-frequency data for trout collected during August and March show that there was a decline in the numbers taken in each two-inch class, except for 2- to 4-inch brook, from the August to the March sampling. The decrease in numbers of trout of all, except one size-class, during the March sampling accounts for the great changes occurring in numbers and total weight taken during this sampling as compared to the February and August sampling.

Figure 2. Length-frequency distribution of cutthroat trout and brook trout collected from sections 2, 3, 4, and 7, area B, Rattlesnake Creek in February and August, 1960, and March, 1961





It is thought that a population peak was sampled in February and August and that a severe natural mortality occurred before the March sampling. Additional year-to-year sampling will test this hypothesis.

Although a length-frequency distribution for rainbow trout and Dolly Varden has not been given, figures show that a decline in numbers of most size-classes occurred between August and March. Another note of interest is that much of the variation in numbers and weight of rainbow trout occurred in one sampling section, section 2 (Table 1).

Total production per acre of water by weight and numbers for all game species is given in Table 3. The catch data from the August sampling has been used for this estimate. The numbers of catchable-size fish (seven inches or longer in total length) is given in Table 4.

Table 3. Total production and production by species per acre of water - Rattlesnake Creek, August sampling.

Area		Cutthroat	Brook	Rainbow	D. Varden	Whitefish	Total
A	No.	77	115	58	38	19	307
	Per cent	25.0	37.5	18.9	12.4	6.2	
	Weight	7.78	6.05	3.74	2.02	1.34	20.93
	Per cent	37.2	28.9	17.9	9.6	6.4	
B	No.	116	69	19	33		237
	Per cent	48.9	29.1	8.1	13.9		
	Weight	36.71	6.31	4.92	7.64		55.58
	Per cent	66.0	11.4	8.9	13.7		
C	No.	121		10	81		212
	Per cent	57.1		4.7	38.2		
	Weight	26.26		1.50	12.91		40.67
	Per cent	64.6		3.7	31.7		

Table 4. Numbers of catchable-size fish (7" or longer) per acre of water - Rattlesnake Creek, August sampling.

Area		Cutthroat	Brook	Rainbow	D. Varden	Whitefish	Total
A	No.	9	9	9	9	9	45
	Per cent*	11.7	7.8	15.5	23.7	47.4	14.7
B	No.	79	17	12	14		122
	Per cent	68.1	24.6	63.2	42.4		51.5
C	No.	67		5	31		103
	Per cent	55.4		50.0	38.1		48.2

* Per cent of numbers produced as given in Table 3.

The data in Table 3 show that area A contains more fish per acre of water than either area B or C, but that these fish weigh considerable less than the fish of either B or C. Area C produced slightly less numbers and weight of fish than area B. In area B and C the cutthroat trout contributed the most numbers and weight of fish. In area A the brook trout were the most numerous while the cutthroat trout weighed slightly more than the brook trout.

In area B and C the largest number of catchable-size trout were cutthroat (Table 4). Table 4 also shows that all species found in area A contributed the same number of catchable-size fish. In Area A, 45 out of 307 were of a catchable-size; in area B, 122 of 237 were of a catchable-size; and in area C, 103 of 212 were of a catchable-size.

Scale samples for age and growth analysis were collected from a representative sample of all trout species taken in areas B and C. No scales were taken from fish collected in area A. These data are presented in Table 5. This age and growth data point out that, in general, the growth of all species is slow. Work by a Montana fishery biologist indicates that in productive waters trout should reach seven inches in total length by the end of the second year of life. Trout from Rattlesnake Creek average between 5.0 and 5.4 inches in total length at the end of the second year of life.

In area B the cutthroat trout and Dolly Varden attained a longer length and lived to an older age than the same species in area C. The growth rate for these species from both areas was similar during the first four years of life. Factors contributing to the greater age and growth of the Dolly Varden and cutthroat trout from area B may be the greater volume of water, apparent greater fertility, and the presence of sculpins. Sculpins were not found in area C. Although no food analysis was undertaken during this study, it is thought that the presence of a forage fish in area B may contribute to the growth of a larger fish.

Table 5. Age and growth of trout from Rattlesnake Creek.

		Length in Inches at Annulus					
Species	Area	I	II	III	IV	V	VI
Cutthroat	B	2.8(82)*	5.4(65)	8.3(40)	10.5(21)	12.6(3)	14.1(1)
Cutthroat	C	3.1(36)	5.4(25)	7.4(13)	10.2(2)		
Dolly Varden	B	2.8(29)	5.1(20)	7.8(10)	11.3(5)	15.0(2)	
Dolly Varden	C	2.8(19)	5.1(13)	7.8(10)	10.0(7)		
Rainbow	B	3.0(4)	5.4(4)	9.0(2)			
Rainbow	C	3.5(4)	5.3(3)	8.0(1)			
Brook	B	2.7(44)	5.0(23)	7.0(11)	8.3(3)	9.9(1)	

* Figure in parenthesis is number in sample.

The small sample size of rainbow trout from either area precludes any comparison of growth rates. Brook trout occurred only in area B.

Techniques Used:

O'Brien Creek and Flower Creek

O'Brien and Flower Creeks were sampled only once during the report period, in September. A shocking section was selected about every two miles throughout the accessible portion of the stream. The sections varied in length, but were all about 300 feet. Two sections in Flower Creek and four sections in O'Brien Creek were electro-fished. Figure 3 gives the locations of these electro-fishing stations.

Each section was blocked off by an electrical seine placed across the upper end and a block net across the lower end of the section. All sections were fished with a 220-volt a.c. generator as the source of electrical power. The sections were fished until all or nearly all fish had been captured.

The captured fish were recorded by species, length, and weight. Scale samples were collected for age and growth analysis. Scale reading and growth calculations were done by the project leader. One total dissolved solids sample was taken from each stream in November by a project biologist from the Northwest Montana Fishery District.

Findings:

O'Brien and Flower Creek

Both O'Brien and Flower Creek are small streams with an average summer-time flow of 20-25 c.f.s. for the former and 15-20 c.f.s. for the latter. Flower Creek is a rushing, torrential stream. It is enclosed in a deep, very narrow canyon along its entire length. O'Brien Creek, for the main part, is a meadow-type stream. Much of its flow originates from springs and seeps in a meadow directly above section 3 (Figure 3). Beaver ponds, both in the stream and to the sides, are very numerous between section 2 and three miles above section 3.

The total dissolved solids samples taken in November gave readings of 37 ppm for O'Brien Creek and 48 ppm for Flower Creek.

Species of fish collected in O'Brien Creek included rainbow trout, brook trout, Dolly Varden, cutthroat trout, and sculpins. Rainbow trout were found only in section 1 (Figure 3), and Dolly Varden were found only in section 2 (Figure 3). These Dolly Varden were observed to be spawning and it is thought that very likely they were migrants from the Kootenai River. The cutthroat trout and the brook trout were the most abundant trout found in O'Brien Creek.

Species of fish found in Flower Creek included cutthroat trout, brook trout, and Dolly Varden. Many of the cutthroat trout were rainbow-cutthroat trout hybrids, but most nearly resembled cutthroat. No fish was found that could have been identified as a rainbow trout. No sculpins were found during this sampling, although two were collected from this stream in 1959.

Figure 3. Sampling sections, Flower and O'Brien Creek, 1960.

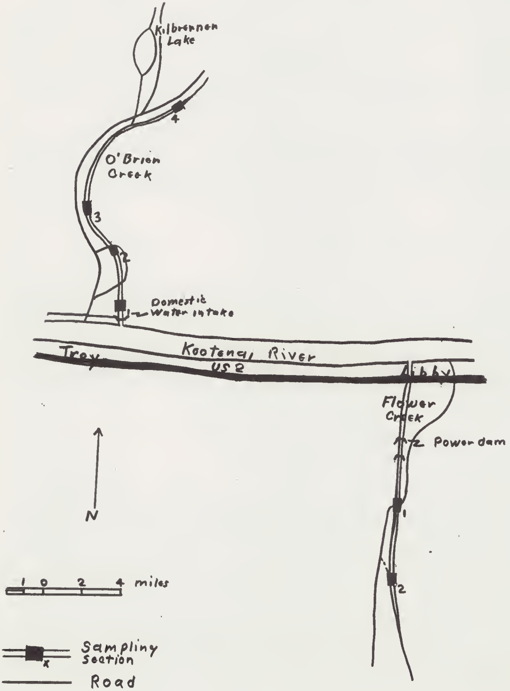


Table 6 gives the results of the electro-fishing by section for both Flower and O'Brien Creeks. The sculpins will not be included in the presentation of data.

Table 6. Catch by section, Flower Creek and O'Brien Creek.

		Cutthroat		Brook		Rainbow		D. Varden		Total	
Stream	Section	No.	Lb.	No.	Lb.	No.	Lb.	No.	Lb.	No.	Lb.
O'Brien	1	6	0.59	3	0.18	7	0.89			16	1.66
O'Brien	2	24	3.11	23	1.32			2	4.34	49	8.77
O'Brien	3	33	6.05	21	0.66					54	6.71
O'Brien	4	4	0.39	32	2.35					36	2.74
Flower	1	21	2.99	9	0.74			4	0.33	34	4.06
Flower	2	39	2.53							39	2.53

A length-frequency distribution for the catch for all sections combined is given in Figure 4. Only cutthroat trout from Flower Creek and cutthroat and brook trout from O'Brien Creek have been graphed.

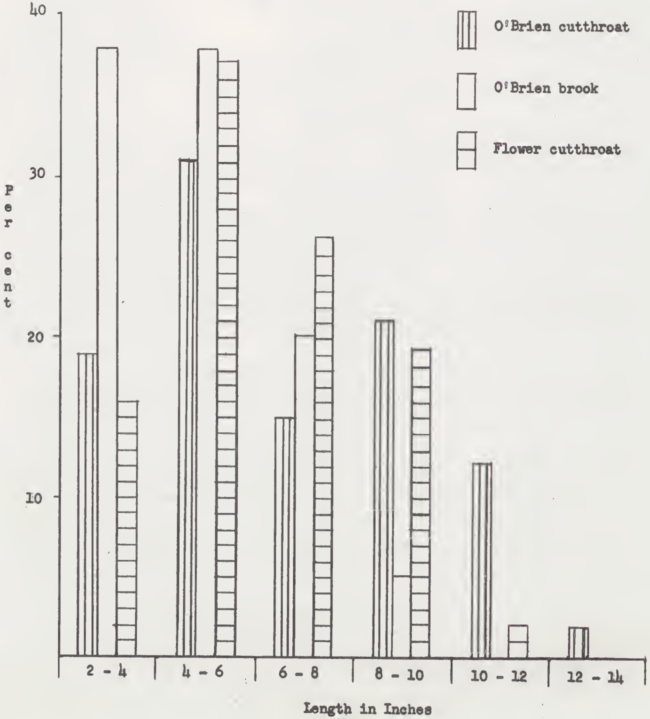
Production per acre of water for each species is given in Table 7. Since it is thought that the two Dolly Varden taken in section 2, O'Brien Creek, were spawning fish from the Kootenai River, these fish have been left out of further discussion and computations.

Table 7. Production per acre of water, O'Brien and Flower Creek.

Stream		Cutthroat	Brook	Rainbow	D. Varden	Total
O'Brien	No.	147	164	15		326
	Per cent	45.1	50.3	4.6		
	Lbs.	22.31	9.92	1.96		34.19
	Per cent	65.3	29.0	5.7		
Flower	No.	360	54		24	438
	Per cent	82.2	12.3		5.5	
	Lbs.	33.12	4.44		1.98	39.54
	Per cent	83.8	11.2		5.0	

Although the brook trout is numerically superior in O'Brien Creek (Table 7), it is apparent from Figure 4 that a majority of the fish were less than 6 inches in total length. About one-half of the cutthroat trout are 6 inches or more in total length. The largest brook taken was in the 8-10 inch class, while several cutthroat were in the next two size classes. The Flower Creek cutthroat follow the same general length-frequency pattern as the O'Brien Creek cutthroat.

Figure 4. Length-frequency distribution (per cent of total caught) of brook trout and cutthroat trout from O'Brien Creek and Flower Creek, 1960.



The number of game fish of a catchable-size (7 inches or longer) per acre of water for both creeks is given in Table 8.

From this table it will be noted that cutthroat trout make up 68.2 and 78.3 per cent of the total number of catchable-size trout from O'Brien Creek and Flower Creek. Table 6 and Table 7 show that from O'Brien Creek the brook trout was numerically superior. Weight-wise, the brook trout made up only about one-fourth of the total production.

In Flower Creek, the cutthroat trout was predominate, both numerically and by weight. There is no marked discrepancy between the total production of fish per acre and the number of catchable-size trout per acre.

Table 8. Number of catchable-size (seven inches or longer) trout per acre of water for O'Brien Creek and Flower Creek.

Stream		Cutthroat	Brook	Rainbow	D. Varden	Total
	No.	62	20	9		91
O'Brien	Per cent	68.2	22.0	9.8		
	No.	108	18		12	138
Flower	Per cent	78.3	13.0		8.7	

Scale samples were collected, read, and growth calculated from a sample of the trout collected from Flower and O'Brien Creeks. This age and growth data is presented in Table 9. These data show that, in general, the brook trout are the slowest-growing and shortest-lived fish of any trout found in either stream. No comparisons can be made from the small samples of rainbow trout taken in O'Brien Creek or from the Dolly Varden taken from Flower Creek. The cutthroat trout taken from Flower Creek were much slower growing than the cutthroat from O'Brien Creek. This difference may be due to the differences in the physical features of the two streams and possibly to the hybridization of the Flower Creek cutthroat trout. The scales of cutthroat of 10 inches or longer from O'Brien Creek were impossible to age and accounts for the lack of age and growth data of fish over 3 years old.

Table 9. Age and growth of trout from O'Brien Creek and Flower Creek.

		Length in Inches at Annulus				
Species	Stream	I	II	III	IV	V
Cutthroat	O'Brien	3.2(48)*	5.8(25)	8.6(14)		
Brook	O'Brien	2.8(34)	4.5(15)	6.3(5)		
Rainbow	O'Brien	2.7(7)	5.2(4)	7.7(2)		
Cutthroat	Flower	2.9(36)	4.8(21)	6.8(10)	8.6(2)	10.8(1)
Brook	Flower	2.7(7)	4.9(3)			
D. Varden	Flower	3.3(3)	5.4(2)			

*Denotes sample size.

Recommendations:

Rattlesnake Creek

Since it is not possible to predict when this stream can be opened to fishing, the program carried out during this report should be repeated. Additional information on the physical and chemical characteristics of the stream should be collected. Weather, time, and available man-power permitting, additional electro-fishing should be accomplished during the winter census. An additional section should be sampled in both area A and C during the summer census.

Recommendations:

Flower and O'Brien Creek

The following recommendations are made for the Flower Creek study:

1. It is planned to open this stream to angling, starting with the fishing season of 1962. Available money and man-power will limit the amount and kind of creel census information gathered, but efforts should be made to gather information during the early part of the fishing season, when pressure will be greatest.

2. This stream is very inaccessible for electro-fishing operations. No additions should or could be made to the sampling program, but the same sections should be sampled as were sampled during this report period.

3. Data should be gathered and calculated on the relative conditions of this hybridized cutthroat population of this stream and compared to a pure cutthroat population.

The following recommendations are made for the O'Brien Creek study:

1. It is planned to open this stream to fishing starting with the fishing season of 1962. Available money and man-power will limit the extent and kind of creel census collected. Every effort should be made to obtain good data during the early part of the fishing season and on as many weekends as possible during the remainder of the fishing season.

2. Additional efforts should be made to collect fish throughout the stream area directly above and below electro-fishing section 3. This additional sampling will have to be done by hook and line or by use of a back-pack shocker.

3. The same sampling program should be followed as was done during this report period.

Prepared by Joe Huston Approved by George D Holton

Date April 15, 1961

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JOB COMPLETION REPORT
INVESTIGATIONS PROJECTS

State of	Montana		
Project No.	F-12-R-7	Name	Western Montana Fishery Study
Job No.	I	Title	Inventory of Waters of the Project Area
Period Covered	May 1, 1960 - April 30, 1961		

Abstract:

Twenty-four streams and nineteen lakes were surveyed during the project period. All waters covered are listed and survey methods used on each are briefly discussed. More inclusive data and discussions are presented for Georgetown Lake, Flint Creek, Clark Fork River, Rock Creek, and Ninemile Creek. Electro-fishing techniques used on Rock Creek and Clark Fork River are described. Management recommendations are discussed for Clark Fork River, Georgetown Lake and mountain lakes. Original survey data are in the district files and duplicates of the permanent record lake and stream survey cards have been sent to Helena.

Objectives:

The overall objective of this job was to catalogue some of the waters of the project area and to determine their value to the fishery management picture of the western district. Specific, additional objectives for certain waters were: (1) Clark Fork River - to assist in assessment of recent pollution damage; (2) Rock Creek and tributaries - to complete the

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general survey coverage of all streams in the Rock Creek creel study area (project F-27-R) and to obtain an index to the fish population of Rock Creek itself; (3) Georgetown Lake - to obtain a second series of population indexes to better evaluate the effects of recent changes in stocking; (4) Ninemile Creek - to initiate evaluation of the experimental fish plant recommended in the F-12-R-6 completion report; (5) Flint Creek - to obtain an index to the numbers of downstream-migrant fry during a year when the spawn trap was not in operation.

Techniques Used:

Twenty-four streams and nineteen lakes were surveyed during the project period. Survey data were recorded on net set record forms, electric stream census forms, and/or field copies of Montana's standard lake and stream survey cards. Original data are in the district files and duplicates of permanent record lake and stream survey cards have been sent to Helena.

The following is a list of common names, abbreviations used, and scientific names used for all species mentioned in this report. Scientific and common names are those listed in the American Fisheries Society Special Publication No. 2, 1960.

Common Name	Abbreviation	Scientific Name
Kokanee	KOK	*Oncorhynchus nerka* (Walbaum)
Coho salmon	SS	*Oncorhynchus kisutch* (Walbaum)
Mountain whitefish	Wf	*Prosopium williamsoni* (Girard)
Golden trout	Gt	*Salmo aquabonita* Jordan
Cutthroat trout	Ct	*Salmo clarki* Richardson
Rainbow trout	Rb	*Salmo gairdneri* Richardson
Brown trout	LL	*Salmo trutta* Linnaeus
Brook trout	Eb	*Salvelinus fontinalis* Mitchill
Dolly Varden	Dv	*Salvelinus malma* (Walbaum)
Lake trout	Lt	*Salvelinus namaycush* (Walbaum)
Arctic grayling	Gr	*Thymallus arcticus* (Pallas)
Redside Shiner	RSS	*Richardsonius balteatus* (Richardson)
Longnose Sucker	F Su	*Catostomus catostomus* (Forster)
Largescale sucker	C Su Col.	*Catostomus macrocheilus* Girard
Sculpin	Cott	*Cottus sp.*

Rock Creek Tributaries

Twenty-one streams, tributary to the 40-mile study section of Rock Creek, were surveyed. Fish populations were sampled by electro-fishing, toxicants, or angling. Weights, total lengths and species were recorded for all fish captured. Physical features of each stream were recorded on standard stream survey forms.

Rock Creek

Seventeen, 300-foot sections of Rock Creek were sampled by electro-fishing. Fourteen of the sections were distributed throughout the length of the 40-mile study section and three were in the ten miles of Rock Creek immediately above the study area.

Water depths from one-foot riffles to ten-foot pools and velocities from 0.5 to over 2 feet per second required the use of different shockers, electrode systems and crew operations. Eight sections were sampled with the 1000-volt, D.C. machine developed under project F-9-R. Conductivity of around 200 micromohs/cm^2 permitted voltages of 800-1000 at 4-6 amperes. At seven of these stations, shore-controlled rubber boats were used for dip-net and electrode operators. Standard nylon or cotton block nets were used where depths and velocities permitted their installation. Otherwise, electric seines, energized by either a 230-volt D.C. or a 230-volt A.C. generator, were used as blocks. At the other station, it was possible for electrode and dip net operators to wade the section.

Five sections were sampled with a 230-volt Homelite model 24 HY generator, using a wiring and electrode system which put 180-cycle, 3-phase current in the water. This generator has been the project's standard shocker since 1956. However, we had previously used only

2-phase current from it because it had been assumed that 3-phase operation would require a full-length, 3-wire extension cord and three electrode operators. Discussion of this problem with the electrician in charge of the 1000-volt shocker unit resulted in the design of a 3-phase wiring system which required only 3 feet of 3-wire cord and which did not require an additional electrode operator for its use.

A 3-wire drop cord, about 3 feet long, was plugged into the generator's 3-phase receptable. At the distal end of this cord two wires were plugged in to our standard 2-wire extension cord leading to the two regular electrodes. The other wire, from the 3-wire cord, was connected to a separate extension cord leading to a third electrode. This single electrode was placed and left on the stream bottom near the center of the shocking section. The other two electrodes were operated throughout the section in a normal manner. This arrangement gave one phase between each of the two operating electrodes and the ground, as well as between each other.

Although no definite comparison tests were made, this 3-phase arrangement appeared to all crew members to be more effective in forming a barrier across the entire stream than did the standard 2-phase electrode setup. It required no more operators than did the 2-phase since the single electrode was left unattended during the entire sampling operation. At the five stations where this system was used on Rock Creek, stream size permitted operators to wade the sections in a normal manner, and standard nylon or cotton block nets were used.

Due to varying water depths and velocities within the remaining four sections, several different combinations of the shockers and methods described above were used.

At least two complete runs were made through each section, and many portions of sections (such as deep holes) were re-worked several times. All fish collected were weighed, measured and recorded by species. Scale samples were collected from a portion of the catch and have been analyzed for age and growth data at the Department fishery laboratory.

Clark Fork River

Twenty, 300-foot sections of Clark Fork River, in its 109 miles between Warm Springs and Missoula, were sampled by electro-fishing. The nine uppermost stations were sampled with a 230-volt, D.C., Homelite generator, using a 2-negative, 1-positive electrode system. River size permitted operators to wade most of each section, and standard block nets were used. The 11 lower sections were sampled with the 1000-volt, D.C. machine mentioned previously. In the greater portions of sections 10 through 19 where water depths were from 3 to 15 feet and volume of flow was from 200 to 500 cfs, both electrode and dip net operation had to be done from shore-controlled, rubber boats. Water depths and velocities also prevented the use of standard block nets in these 10 sections and electric seines were used for both upper and lower blocks. Personnel stationed along the lower block seine collected when possible, or at least enumerated, fish "turned" by the seine's field as they attempted to, or did, escape from the section. Conductivity of over 600 micromohs/cm^2 limited the large shocker to 300-400 volts at which drop the machine's maximum amperage (10) was drawn. Section 20 was on a channel of the river which contained about one-third of the river's total flow. Dip net and electrode operators waded the section. Lengths and weights were recorded for all fish captured. Scale samples were taken from all game fish

collected, but total catch was so low that age and growth data were not calculated.

Ninemile Creek

The same three sections of Ninemile Creek which had been sampled in 1959 were electro-fished again this year. The 1960 sampling occurred about four weeks after the experimental plant of 2,100, 3- to 4-inch cutthroat trout which had been recommended last year. All fish captured were weighed, measured and recorded by species.

Flint Creek

A down-migrant fry trap was constructed and installed in Flint Creek, above Georgetown Lake, on July 13, 1960. This trap was designed to capture fry from about one-half the width of the creek. Installation was at the same location as that of the trap operated in the summer of 1958. Except for its removal during the period July 26 to August 7, the trap was checked daily, the total catch counted, a portion of the catch preserved and the rest were released. The trap was removed on August 25.

Mountain Lakes

Seventeen of the lakes surveyed were not accessible to 2-wheel drive vehicles. Crews transported survey gear to one of these lakes in a 4-wheel drive vehicle, to seven others by back-packing, and to the remaining nine by the use of pack stock. All lakes were sketch mapped and sounded. Fish populations were sampled by netting in 18 lakes, by angling in one. Lengths, weights and species were recorded for all fish captured and scale samples were taken from a portion of the catches. These have been analyzed for age and growth by project personnel. Physical features were

recorded on standard lake survey forms. A ground measurement between two prominent physical features of each lake's shoreline area was made at the time of survey. Aerial photos were taken of all lakes, the scale of each photo was computed from ground measurements, and an outline map of each lake was pantographed from its photograph. Areas were determined by polar planimeter from the outline maps, sounding and net set locations were transferred from the field sketch map to the final outline maps on the lake survey cards.

Smith Lake

Smith Lake, a small, shallow, man-made impoundment near Lincoln, was surveyed. The lake was sounded and sketch mapped and two standard experimental gill nets were fished overnight. Fish captured were weighed, measured and recorded by species. Scale samples were collected and are being read by project personnel. Physical features were recorded on the standard lake survey form.

Georgetown Lake

Thirty overnight gill net sets were made in Georgetown Lake from June 19 through June 24, 1960. Location of sets approximated those of similar sets made during the 1958 survey of this lake. All fish captured were weighed and recorded by species. Scale samples are being read at the Department fishery laboratory in Bozeman. Because large numbers of game fish were captured, they were worked as rapidly as possible, iced and turned over to the local warden for delivery to the state hospital at Warm Springs.

Findings:

Rock Creek Tributaries

Table 1 lists the 43 tributaries of Rock Creek within the creel study area of Project F-27-R. Three streams remain to be sampled for fish: Alder, Dalles and Wyman creeks. Twenty-two streams were surveyed in 1959 and 21 in 1960. Twenty of the sampled streams were found to contain fish and the other 20 were found to be ephemeral and of no fishery value.

Anglers checking through the Rock Creek stations consistently report catches from only 10 of the 20 tributaries which contain fish. Undoubtedly some catches from the other 10 streams occur, and are not reported. This may be due to either unfamiliarity of some anglers with the area or simply to inaccurate reporting. However, it is safe to assume that the 10 streams from which catches are consistently reported, provide the tributaries' major contribution to the study area's catch.

Rock Creek

The catch by numbers and species from the 17 sections of Rock Creek is shown in Table 2. No detailed analysis and discussion of these data is presented since their primary usefulness will not be realized until they can be compared with similar data collected after several years of no planting in Rock Creek. Sections 1 through 14 are in the study area, which has been planted annually with catchable rainbow trout for at least 10 years. Sections 15, 16 and 17 are above the study section. The creek in this area has not been planted for the last two years. The average number of wild trout captured per section was 17.6 within the study area and 12.7 above. The average catch of whitefish per section was 70 within the study area and 111 above. These whitefish represent a greatly under-

utilized population of game fish in Rock Creek. They comprised 79 per cent of the game fish captured from our 17 shocking sections, and yet they have made up only about 25 per cent of the total angler catch from the study section for both summer and winter seasons combined. They have made up less than 10 per cent of the total game fish catch during the summer seasons only.

Age and growth data from the scale samples collected during the Rock Creek shocking are presented in Table 3. The same data for whitefish and rainbow trout are summarized for two divisions of the stream in Table 4.

Because low numbers of trout scale samples were collected during the shocking of Section II of the study area, data from these collections were combined, in Table 4, with data from the collections made in the area above the study section. Faster growth for both whitefish and rainbow trout in the larger, slightly warmer, lower section (Section I of the study area) is indicated by these data.

Clark Fork River

The total numbers of fish, both captured and observed during the Clark Fork shocking, are shown by section and species in Table 5. Of the numbers shown, only four whitefish and two suckers were observed and not collected. In addition to the numbers of fish shown in the table, large numbers of fry (mostly redside shiners and suckers) were observed at many of the stations. Their small size made them difficult to collect and no attempt was made to enumerate them. Only their presence was recorded.

The average catch per section for the total river reach sampled, and for three divisions of that reach, are summarized in Table 6. No attempt was made to compute the statistical limits of these average catch figures because of the extremely low total catch. It is unfortunate that similar shocking data from previous years are not available for comparison. However, a tributary of the upper Clark Fork, Little Blackfoot River, has been sampled in 1956, 1957 and 1959. The lower portion of this stream is somewhat similar to Clark Fork River in its location, drainage basin and gradient although it is smaller in size and has not been affected by the recent pollution of the Clark Fork. The shocking data from Little Blackfoot River, which were discussed in detail in the completion report for Project F-12-R-6, are summarized in Table 7 for comparison. They emphasize a low population in Clark Fork River.

Clark Fork River, from Garrison to Milltown Dam, was closed to angling following severe mine pollution in March, 1960. The extreme turbidity of the pollutant, combined with high water runoffs, precluded any direct observation of either fish or insect kills. During the period of pollution, however, live-cages containing rainbow trout were placed at six sites from 3 miles above Milltown Dam downstream for a distance of 87 miles. Observed fish mortalities in these live-cages substantiated the assumption that the pollution very likely reduced fish numbers to such a low level that the remaining game fish would be too few to utilize all available spawning areas. The closure was made to protect surviving fish for subsequent spawning and repopulation of the affected portion of the river.

The section of the river from its headwaters to Garrison is classified as industrial and was not closed because it may very well receive

receive lethal pollution again in the future. No successful angling is known to have taken place in this area during the summer of 1960.

Survey data collected subsequent to the closure supported the decision to close the stream section. Even considering a shocking efficiency as low as 10 per cent (and we believe it was somewhat higher than that overall) female brown trout would number less than 10 per mile for Clark Fork River upstream from Rock Creek. Based on these shocking data and information on the insect populations from the Pollution Biologist's study, management recommendations were made to keep the section of Clark Fork River from Garrison to Rock Creek closed for another year, and to open that section from Rock Creek to Milltown Dam with the general season on May 21, 1961. It is also recommended that the sampling be repeated in 1961 to evaluate recruitment from reproduction and immigration.

Ninemile Creek

The numbers of fish, by species and section, collected from Ninemile Creek in 1959 and 1960 are shown in Table 8. The total catch of cutthroat trout for each year is presented by 2-inch length intervals in Table 9. Figure 1 is a graphic presentation of the data from Table 9 for the length intervals from 2.0 to 9.9 inches. Catch of all species was somewhat better in 1960 than in 1959. The cutthroat catch increase was principally due to large numbers of fish in the 2.0 to 5.9-inch groups. This would be expected since the fish planted in the stream one month before the sampling were mostly in the 3-to 4-inch size range. It is recommended that planting and sampling continue for another two years as planned.

Flint Creek

Data obtained from fry trap operations in Flint Creek in 1958 and 1960 are presented in Table 10. All fry collected are known to be trout. Although not keyed out to species, they are assumed to be cutthroat and rainbow trout fry. No other spring-spawning salmonoids, except arctic grayling, are present in the drainage, and no key is known that will separate rainbow and cutthroat trout in the fry stage.

The Montana hatchery system operated a spawn trap at the mouth of Flint Creek in 1958, and for many years prior to that time. During normal trap operation racks were installed before the start of the run and completely blocked natural upstream movement of migrating fish. Whenever egg requirements were filled the racks were removed from the trap and whatever part of the run remained, if any, could then proceed upstream to spawn naturally. This trap was not operated in 1960.

Due to a full schedule of other field work, the fry-trapping phase of this job was limited by lack of manpower. Consequently, the trap was not installed as early nor operated as continuously as was desired.

A comparison of total or average numbers of fry captured per day would not be satisfactory. The 1958 total number of fry would be lower because the trap was operated fewer days, while the 1960 average would be lower because the trap operation continued until the migration was practically over. The average catch per hour would also give an incorrect comparison because only the 1960 operation included the relatively unproductive daylight hours.

In 1958, 814 fry were captured in the four days the trap was operated during the period five days before and five days after the day of heaviest

catch (August 3). Two thousand thirty-two fry were taken during the 11 days of operation in a comparable period around the 1960 day of maximum catch (July 19). The average catch per day for these periods was 203 fry in 1958 and 185 fry in 1960. It is unlikely that this difference is significant.

Mountain Lakes

The 17 mountain lakes surveyed during this report period are listed in Table 11. Each lake's location, size, and catch data summary are included in this table. None of the lakes' basins, with the exception of Middle Bowman and Fuse, have been altered for water level manipulations.

Middle Bowman is impounded for irrigation water storage. There are plans to raise the present dam to increase the lake's volume and drawdown. The lake was surveyed to obtain fish population data prior to further impoundment. A post-impoundment survey will be made to obtain comparative data.

The Fuse Lake outlet was lowered at an undetermined date to obtain water for sapphire mining operations. The lake has no inlet and the outlet was not flowing at the time of survey. Arctic grayling were planted in the lake in 1952 and have apparently reproduced successfully in shore areas. Scale samples obtained from 43 grayling caught during 6 hours of angling were impossible to read beyond the second annulus, so growth rates could not be computed. However, two distinct size ranges were noted in fish caught and fingerlings were observed in shore areas. Fish taken appeared to be in poor condition.

No fish were netted in four of the lakes. The game-fish population of eight lakes was composed solely of brook trout. Three lakes contained mixed rainbow and cutthroat trout populations and one lake contained only rainbow trout. The arctic grayling was the only fish taken in Fuse Lake and non-game fish were found only in Heart Lake.

Age and growth data calculated for fish obtained from the lakes surveyed are presented in Tables 12, 13 and 14. From these data it appears that the brook trout exhibits a faster growth rate than either the cutthroat or rainbow trout during its first year of growth to the time of the third annulus formation. In most of these lakes, no brook trout over three years old were taken. This condition has been reported from several other brook trout areas in the west.

Angling in most of the brook trout lakes is presently popular with only a small segment of Montana's mountain-lake anglers. Most residents desire a larger sized fish from lakes, although the average size of the brook trout in many of these lakes is larger than that of the catchable-sized fish that are stocked in Montana's streams. Quite possibly these contradictory views represent two different groups of anglers. The novice fisherman who enjoys taking hatchery fish from a road-side stream requires considerably smaller fish for his satisfaction than does the more experienced angler who expends considerable effort to reach remote mountain lakes.

Management measures which could possibly increase fish size in these lakes are: (1) removal of creel limits and seasons, (2) rehabilitation, and (3) planting of some other species which has a potential for larger growth.

It is doubtful that even complete removal of seasons and bag limits could increase angling pressure enough to improve the growth rate of these brook trout. Silver and Diamond Lakes, in the same area and both accessible by road, have been under a no-closed-season, no-bag-limit regulation since 1956. The average total length of brook trout in experimental, gill-net catches from Silver Lake was 8.5 inches in 1955 and 8.1 inches in 1958. However this measure should still be adopted for the other brook-trout lakes, if only to allow better utilization of fish.

Rehabilitation could be used to replace present brook trout populations with rainbow or cutthroat trout. However it seems an expensive tool to use, except experimentally, on relatively infertile lakes that are already producing high numbers of fish which are of a size desirable to some Montana anglers.

If some other species, such as rainbow trout, could be successfully introduced, a few of their numbers should eventually reach a size at which they could begin to utilize the brook trout as food. Better growth rates for the new species from this point on should then provide a few larger sized fish for the more particular anglers. Total production of large fish could never be expected to be high, but the brook trout would remain for those anglers interested mainly in catching large numbers of fish.

Following are management recommendations for the mountain lakes surveyed in 1960.

French, Lower Trio and Lower Siamese: Natural reproduction is sufficient to maintain the population. No stocking necessary, no change in regulations recommended.

Pearl and Dalton: These are suitable for fish and have no fish present. Plant 100 per acre golden trout or arctic grayling when available. Re-survey 4 to 5 years after first plant to evaluate reproduction.

Middle Trio: No fish present, lake is too shallow for management.

Upper Siamese: No fish present, lake is suitable for management but no stocking is recommended at present. Lower Siamese, which is adjacent to the trail to the upper lake is under-harvested now. Creating a fishery in the upper lake would reduce the already low pressure on the lower lake.

Heart, Upper Trio, Middle Oregon, Lower Oregon, Left Bonanza, Right Bonanza: Remove the season and bag limit on eastern brook trout and publicize the fishing quality of these lakes.

Missoula and Lost: Remove the season and bag limit on eastern brook trout and publicize the fishing quality of these lakes. Include with Silver and Diamond Lakes in the following experimental management measures:

Missoula: Rehabilitate and plant with 2-inch rainbow trout at the rate of 100 per acre.

Lost: Plant with a predator species: Dolly Varden, brown or lake trout, whichever is most readily available. Size should be from 3 to 6 inches depending on availability. Number per acre to be determined by size of fish from Montana's lake stocking table with the lake rated PPN (fertility poor, accessibility poor, reproduction nil). If none of these other species are available plant 4-inch rainbow trout at the rate of 30 per acre.

Diamond: Plant 4-inch rainbow trout at the rate of 30 per acre.

Silver: Plant 7-inch rainbow trout at the rate of 15 per acre.

Fish populations in these four lakes should be sampled by netting within 2 years after stocking. Each lake is at or near the end of a road, thus later surveys will not require the use of pack stock.

Fuse: No stocking is necessary, no change in regulations. Publicize the fishing quality of this lake.

Middle Bowman: No change in regulations, no stocking necessary. Repeat survey periodically for several years after the dam is raised.

Smith Lake

Smith Lake, near Lincoln, Montana, is an impoundment of 15-20 surface acres with a maximum depth of 7 feet. It was first planted with rainbow trout in 1930 and since that time has been operated infrequently, and with little success, as a commercial fish pond. The lake was offered for sale to the Fish and Game Department in 1960.

On October 12-13, 1960, two gill nets were fished overnight and took the following fish: 81 largescale suckers, 17 longnose suckers, 6 brook trout, 3 cutthroat trout and 2 rainbow trout. The drainage area for the lake is less than 1 square mile. A diversion from nearby Stonewall Creek supplies most of the lake's water. The diversion headgate structure and the dam's spillway are in poor condition. It was recommended that the Department not purchase this lake.

Georgetown Lake

Total numbers of fish, by species, taken from the 30 overnight gill-net sets in Georgetown Lake are presented in Table 15. Catch data obtained

from the 1958 gill net series and per cent change from 1958 to 1960 are included for comparison. Cutthroat and rainbow trout are the predominate game-fish species found in the lake and the longnose sucker is the principal non-game fish. Confidence limits at the 80 per cent level were calculated for the mean catch per set of cutthroat trout and longnose sucker for 1958 and 1960. These data are shown in Table 16. The small number of rainbow trout taken in 1958 prohibited computation of fiducial limits for this species.

The number of cutthroat trout taken in 1960 did not change significantly from the catch in 1958. There was a significant decrease in the mean catch of longnose suckers. While confidence limits were not computed for the mean catch per set of rainbow in 1958, it is obvious that the increase in 1960 has a high probability of being significant.

Apparently the longnose sucker population has decreased. The only known change that this could be attributed to would be the increase in numbers of rainbow. While the size of the rainbow planted precludes the possibility that this reduction could have been an effect of predation on suckers by the rainbow, it is possible that the rainbow has been able to utilize available food and space to the detriment of the sucker population.

The total catch of all species decreased from 3,246 fish in 1958 to 2,596 fish in 1960. This was a 20 per cent reduction. However the ratio of game fish to non-game fish increased from 17 to 83 per cent in 1958 to 30 to 70 per cent in 1960. The catch of game fish increased 41.5 per cent and the catch of non-game fish decreased 32.8 per cent. A comparison of these data indicates that the addition (in 1958 and 1959) of rainbow trout to the Georgetown Lake planting program, has been beneficial to the game fish population of the lake.

It is recommended that the present planting program (approximately 300,000 each of 3-inch or larger rainbow and cutthroat trout) be continued as long as the hatchery system needs Georgetown Lake as a source of cutthroat eggs. When this need no longer exists, the cutthroat portion of the plant should be replaced with rainbow. If the spawn traps are closed permanently, then the total plant should be reduced to 300,000, 3-inch rainbow trout.

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Date: May 15, 1961

TABLE 1. SUMMARY OF ROCK CREEK TRIBUTARIES SURVEYED, 1959-60.

Stream	Surveyed in 1959	Surveyed in 1960	Contains Fish	No Fish Found
Alder		x	NOT SAMPLED	
Basin	x			x
Bear Gulch		x		x
Big Spring		x	x	
Bobcat	x		x	
*Brewster		x	x	
Butte Cabin	x		x	
Cinnamon Bear		x	x	
*Cougar	x		x	
Dalles		x	NOT SAMPLED	
Eagle		x		x
Fiddler Gulch	x			x
*Gilbert	x		x	
Goat	x			x
Gratton Gulch		x		x
**Grizzly	x		x	
Hamm Gulch	x			x
Harry's Gulch	x		x	
*Hogback	x		x	
Howell	x			x
Hutsinpilar		x		x
*Kitchen Gulch	x		x	
Little Hogback	x		x	
Palouse Gulch		x		x
Pawnee Gulch		x		x
*Ranch	x		x	
Richard's Gulch		x		x
Sawmill		x	x	
Schively Gulch		x		x
Sheep Gulch	x			x
Solomon		x	x	
Spring	x		x	
*Stony	x		x	
Tamarack Gulch		x		x
Tekoa Gulch		x		x
Tindall Gulch	x			x
Waho	x			x
Walquist		x	x	
*Welcome		x	x	
West Gulch	x			x
Williams Gulch		x	x	
Windlass Gulch	x			x
*Wyman		x	NOT SAMPLED	
TOTAL	22	21	20	20

* - Streams known to contribute to the fishery.
** - Secondary tributary.

TABLE 2. ROCK CREEK ELECTRO-FISHING CATCH, BY SPECIES AND SECTION, 1960.

Station Number	Nat Rb	1960 Rb	1959 Rb	Dv	Ct	Eb	LL	FSu	Dace	Cottus	WF	C Su.Col.	RSS
1	7						8	23			47	10	14
2	8		1			1	7	1	16	15	17		
3	26	10		1		1	3	7	3	2	93		
4	9					1		19	19	29	75		
5	3	1		1				1	13	15	19		
6	10	4		3				8			17		
7	17	8		2			1	9		9	95		
8	13	13							3	5	64		
9	19	23		2	2			1	10	11	96		
10	13	3		2				13	1	2	95		
11	4			3	1	3		11	5	3	16		
12	15	4		2	2			32	33	23	91		
13	3			2	5				14	7	111		
14	34	6			5	7		55	10	53	141		
Sub-total	181	72	1	18	15	13	19	180	127	174	977	10	14
15	7			2	2	4		5		27	211		
16				8	12			2	5	19	40		
17	1			1	1			2			82		
Sub-total	8	--	--	11	15	4	--	9	5	46	333	--	--
Grand Total	189	72	1	29	30	17	19	189	132	220	1,310	10	14

TABLE 3. AGE AND GROWTH FOR SPECIES COLLECTED DURING ROCK CREEK ELECTRO-FISHING, 1960.

Species	I	II	III	IV	V	VI	VII	VIII	IX
	Average length at annulus								
Whitefish	2.8 (377)*	6.2 (209)	8.8 (168)	10.6 (94)	12.4 (49)	13.5 (28)	13.9 (16)	16.7 (3)	17.4 (1)
Rainbow	2.9 (118)	6.4 (40)	10.2 (17)	12.1 (5)	14.8 (3)				
Cutthroat	2.9 (29)	5.1 (9)	10.6 (1)						
Brown	5.1 (1)	8.6 (1)	14.1 (1)						
Dolly Varden	3.1 (23)	6.2 (23)	9.0 (16)						
Brook	3.6 (10)	6.1 (6)							

TABLE 4. SUMMARIZATION, BY SECTION, OF AVERAGE LENGTH AT ANNULUS FORMATION FOR TWO SPECIES COLLECTED DURING ROCK CREEK ELECTRO-FISHING, 1960.

Species and Section	I	II	III	IV	V	VI	VII	VIII	IX
	Average length at annulus								
Whitefish									
Lower**	3.0 (156)	6.4 (130)	9.0 (110)	11.0 (52)	12.7 (25)	14.1 (15)	15.2 (7)	16.5 (1)	17.5 (1)
Upper	2.7 (114)	5.8 (79)	8.3 (58)	10.0 (42)	12.0 (24)	12.8 (13)	14.4 (8)	16.8 (2)	
Rainbow									
Lower	2.9 (61)	6.5 (27)	10.2 (16)	12.1 (5)	14.8 (3)	19.2 (1)			
Upper	2.9 (57)	6.2 (13)	10.5 (1)						

* - Numbers in parenthesis denote sample size.

** - Lower section includes Section I of Rock Creek [illegible]el census study area only. Upper section includes both Section II of study area and stre[illegible] above study area.

TABLE 5. SUMMARY OF CATCH BY SECTION*, CLARK FORK RIVER, AUGUST, 1960.

Section No.	Brown Trout		Brook Trout		Cutthroat Trout		Whitefish		Rough Fish	
	Over 10"	Under 10"	Over 10"	Under 10"	Over 10"	Under 10"	Over 10"	Under 10"	Over 10"	Under 10"
1	1	0	0	0	0	0	0	0	0	0
3	1	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	1	0
6	0	0	1	0	0	0	0	0	0	0
7	0	0	0	0	0	0	4	4	0	0
8	0	0	0	0	0	0	0	16	0	1
9	0	2	0	0	0	0	2	0	20	0
10	4	0	0	0	2	1	0	0	1	0
12	0	0	0	0	0	0	0	1	0	0
14	1	0	0	0	0	0	0	0	93**	0
17	0	0	0	0	0	0	0	0	2	2
18	0	0	0	0	0	0	0	0	0	1
19	0	0	0	0	0	0	3	0	3	1
20	7	3	4	0	0	0	45	0	37	0
TOTAL	14	5	5	0	2	1	54	21	157	5

* - No fish captured or observed at Sections 2, 4, 11, 13, 15 or 16.

** - All 93 fish weighed 0.41 lb.

TABLE 6. AVERAGE CATCH PER 300-FOOT SHOCKING SECTION FOR VARIOUS PORTIONS OF THE CLARK FORK RIVER, AUGUST, 1960.

LOCATION	TROUT	WHITEFISH	ROUGH FISH
Entire Section. Warm Springs to Bonner Dam Sec. 1-20, 109 mi.	1.4	3.8	8.3
Warm Springs to Garrison Sec. 1-7, 28 mi.	0.4	1.1	0.1
Garrison to Rock Creek Sec. 8-19, 63 mi.	0.8	1.8	10.0
Rock Creek to Bonner Dam Sec. 20, 18 mi.	14.0	45.0	37.0

TABLE 7. AVERAGE CATCH PER 300-FOOT SHOCKING SECTION, LITTLE BLACKFOOT RIVER, 1956, 57, 59.

YEAR	BROWN TROUT	WHITEFISH	ROUGH FISH
1956	87.4	89.0	13.7
1957	77.0	97.0	10.4
1959	33.7	46.0	8.0

TABLE 8. NUMBERS OF FISH, BY SPECIES AND SECTION, COLLECTED DURING THE 1959 AND 1960 SAMPLING ON NINEMILE CREEK.

Section No.	Ct		Eb		Dv		Wf		F Su		Cott	
	59	60	59	60	59	60	59	60	59	60	59	60
1	20	49	6	20	0	0	13	10	0	3	30	27
2	9	46	4	3	0	0	1	7	0	0	2	6
3	20	33	4	8	1	6	0	0	0	0	5	5
TOTAL	49	128	14	31	1	6	14	17	0	3	37	38

TABLE 9. NUMBERS OF CUTTHROAT TROUT, BY 2-INCH LENGTH INTERVALS, COLLECTED FROM NINEMILE CREEK SHOCKING SECTIONS in 1959 AND 1960.

Length Intervals	Nos. of Fish	
	1959	1960
2.0 - 3.9"	19	40
4.0 - 5.9"	18	59
6.0 - 7.9"	11	19
8.0 - 9.9"	1	7
10.0 - 11.9"	0	1
12.0 - 13.9"	0	2
TOTAL	49	128

FIGURE 1. COMPARISON OF NUMBERS OF CUTTHROAT TROUT BY 2-INCH LENGTH INTERVALS FROM NINEMILE CREEK, 1959-1960.

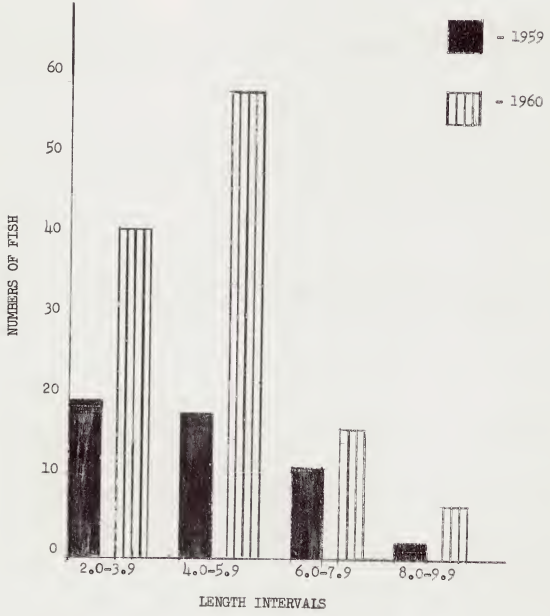

TABLE 10. DURATION OF FLINT CREEK FRY TRAP SET AND NUMBERS OF FRY CAPTURED, 1958 AND 1960.

Date		Hours fished 1958	Hours fished 1960	Number of fry captured 1958	Number of fry captured 1960
July	14		21		100
	15		22		158
	16		26		161
	17		22		351
	18		24		41
	19		25		700
	20		23		313
	21		26		131
	22		22		10
	23		24		22
	24		26		45
	25	10	24	60	26
	26				
	27	10		27	
	28-31	Trap not operated either year			
August	1	12		139	
	2	13	8	181	7
	3	11	24	380	9
	4		24		11
	5		24		0
	6		24		0
	7	14	24	114	1
	8		24		0
	9		24		1
	10		24		1
	11		24		1
	12	12	24	10	4
	13	13	24	27	1
	14		24		0
	15		24		0
	16	12	24	20	0
	17		24		0
	18		24		0
	19	12	24	25	0
	20		24		0
	21		24		0
	22		24		0
	23		24		1
	24		24		0
	25		24		0

TABLE 11. LIST OF HIGH MOUNTAIN LAKES SURVEYED, 1960.

Lake	Location	Size (acres)	Overnight Sets	Species Collected	Number Collected
Bonanza, Left	T15N R28W S3 Mineral Co.	10	2	Eb	42
Bonanza, Right	T15N R28W S3,4 Mineral Co.	19	2	Eb	42
Bowman, Middle	T7N R12W S31 Powell Co.	11	10	Rb Ct	17 90
Dalton	T14N R26W S24 Mineral Co.	6	2	No fish taken	
French	T14N R26W S18 Mineral Co.	18	2	Rb	24
Fuse	T6N R17W S27 Granite Co.		Hook and Line 6 f'man hrs.	Gr	43
Heart	T14N R27W S23,26 Mineral Co.	60	2	Eb F Su	40 3
Lost	T16N R28W S34 Mineral Co.	40	2	Eb	60
Missoula	T15N R28W S15 Mineral Co.	14	2	Eb	50
Oregon, Lower	T15N R28W S13 Mineral Co.	5	2	Eb	23
Oregon, Middle	T15N R28W S13,14,24 Mineral Co.	27	2	Eb	46
Pearl	T14N R27W S24 Mineral Co.	14	2	No fish taken	
Siamese, Lower	T13N R26W S29 Mineral Co.	34	2	Rb Ct	11 11
Siamese, Upper	T13N R26W S29 Mineral Co.	28	2	No fish taken	
Trio, Lower	T14N R27W S36 Mineral Co.	12	2	Rb Ct	5 2
Trio, Middle	T14N R26-27W S25,30, 36,31 Mineral Co.	7	2	No fish taken	
Trio, Upper	T14N R26W S30,31 Mineral Co.	8	2*	Eb	8

* - Nets fished only 3 hrs. in Upper Trio Lake.

TABLE 12. AGE AND GROWTH OF BROOK TROUT FROM EIGHT MOUNTAIN LAKES, 1960

Lake	Average length in inches at annulus I	II	III	IV
Heart	3.1 (36)*	6.1 (36)	8.7 (31)	
Left Bonanza	3.1 (38)	6.0 (38)	7.3 (6)	
Lost	2.9 (47)	5.9 (47)	7.5 (1)	
Lower Oregon	2.9 (15)	5.4 (15)	7.2 (8)	
Middle Oregon	3.1 (42)	6.5 (42)	8.2 (8)	
Missoula	3.3 (51)	6.5 (51)	8.3 (14)	
Right Bonanza	3.1 (39)	6.1 (39)	7.1 (2)	
Upper Trio	2.1 (7)	4.5 (7)	6.4 (5)	8.4 (3)

TABLE 13. AGE AND GROWTH OF CUTTHROAT TROUT FROM THREE MOUNTAIN LAKES, 1960

Lake	Average length in inches at annulus I	II	III	IV	V	VI
Lower Siamese	2.3 (10)	5.4 (10)	7.6 (8)	9.6 (4)	11.1 (4)	
Lower Trio	1.7 (2)	3.5 (2)	6.5 (2)	8.8 (2)	10.8 (2)	11.2 (1)
Middle Bowman	2.7 (90)	6.2 (90)	8.3 (60)	10.8 (3)		

TABLE 14. AGE AND GROWTH OF RAINBOW TROUT FROM FOUR MOUNTAIN LAKES, 1960

Lakes	Average length in inches at annulus I	II	III	IV	V	VI
French	2.0 (24)	4.7 (24)	7.5 (23)	9.9 (7)	11.9 (4)	13.9 (2)
Lower Siamese	2.5 (12)	5.0 (12)	7.8 (12)	9.7 (8)	11.4 (7)	12.9 (5)
Lower Trio**	1.5 (7)	4.1 (5)	6.3 (5)	8.4 (4)	10.7 (3)	13.0 (2)
Middle Bowman	2.1 (17)	4.6 (17)	7.2 (14)	7.7 (8)	10.0 (5)	

* - Figures in parenthesis denote sample size.
** - Calculated lengths of one fish (TL-18.4") at annuli VII and VIII omitted.

TABLE 15. GILL NET CATCH, BY SPECIES, AND PER CENT CHANGE, GEORGETOWN LAKE, 1958 AND 1960.

	Species								TOTAL	
Year	Ct	Eb	Rb	SS	Gr	KOK	F Su	RSS	Game Fish	Non-game fish
1958	458	77	10	3	10	0	2,604	84	558	2,688
1960	443	62	279	1	3	2	1,790	16	790	1,806
Per cent Change	-3.3	-19.3	+2,690	-66.6	-70.0	+200	-31.2	-81.0	+41.5	-32.8

TABLE 16. MEAN, STANDARD DEVIATION, AND CONFIDENCE LIMITS (80%) FOR GEORGETOWN LAKE GILL NET SERIES, 1958 AND 1960

Year					Confidence Limits at 80 per cent level
			Cutthroat trout		
1958	30	458	15.26	12.59	12.25-15.26-18.27
1960	30	443	14.75	9.21	12.55-14.75-16.95
			Longnose sucker		
1958	30	2,604	86.80	45.49	75.93-86.80-97.67
1960	30	1,790	59.66	31.29	52.18-59.66-67.14

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[JOB] COMPLETION REPORT
[IN]VESTIGATIONS PROJECT

State of Montana

Name Western Montana Fishery Study

Project No. F-12-R-6

Title Inventory of Waters of the Project Area

Job No. I (Supplemental Report)

Effects of Forest Spraying with DDT on Aquatic Life

Period Covered May 1, 1959 - April 30, 1960

ABSTRACT:

In the early summer of 1959, the U. S. Forest Service conducted an aerial DDT spray program for the control of the spruce budworm in certain areas of the East and West Forks of the Bitterroot River drainage. In order to determine the effects of the spraying upon the aquatic habitat of the area, a fishery study was conducted coincident with the spraying. Insect life in the streams within the spray areas was sampled before, during, and after the spraying. The spraying was observed by department personnel, both from the ground and from the air.

Several severe insect kills were correlated with various phases of the spray application and one minor fish kill occurred coincident with the spray operation, but no major fish kills are known to have occurred that could be attributed solely to the DDT spray.

OBJECTIVES:

To determine the effects of aerial application of DDT for spruce budworm control upon the aquatic environment. To predict, if possible, future effects on the fishery in order to determine the necessity of instigating special management measures on waters of the spray area. To observe as much of the spray application job as possible. To compare determined effects on habitat with observed methods of application, in order to make any feasible recommendations possible for the reduction of damage from future spray jobs.

TECHNIQUES USED:

The spray was applied from airplanes at the rate of one pound of DDT emulsified in one gallon of oil per acre of forest. The spraying was accomplished in the early morning hours of from dawn to about 10:00 a.m. The pilots were instructed to turn off the spray when crossing non-forested land and to stay at least one-quarter mile away from the streams of importance in the spray area.

Prior to the application of the DDT spray, sample sites were picked on all streams within the spray boundaries. In addition, some sample sites were chosen outside of the spray area for control.

PLEASE RETURN

Before and after the application of the spray one, four-square-foot, bottom sample was taken at most of the stations on each collecting date. The bottom sampler consisted of a four-square-foot metal frame to outline the sample area and a collecting net made of common window screen fastened to wooden poles. The bottom within the metal frame was agitated until all, or nearly all, insects were dislodged and washed into the wire screen. The insects were then picked from the screen and preserved for later identification. All of the bottom samples were taken from riffle areas and care was taken to avoid sampling the same four-square-foot area more than once.

Drift samples were taken from some of the bottom sampling sites during and following the spraying. These drift samples were collected by holding a screen similar to that used for the bottom samples in the stream for a period of time ranging from 30 seconds to five minutes. The time that the screen was held in the stream was dictated by the amount of insects floating downstream. The screen was then picked of insects and these insects preserved for later identification and measuring.

The bottom and drift samples were sent to the department fishery laboratory to be measured and identified. Data recorded for each sample included the identification of the insects to the following groups: Ephemeroptera (mayflies), Diptera (trueflies), Plecoptera (stoneflies), and miscellaneous. The miscellaneous catagory included the Coleoptera, Odonata, Hemiptera, Trichoptera, Annelida, and Nematoda. Each of the groups were measured volumetrically to the nearest one-tenth cubic centimeter. Volumes less than one-tenth cubic centimeter are expressed as a trace (T).

Observations of the spraying operation were made by personnel stationed on the ground and from personnel in a department airplane. Notes were kept on the effectiveness of the spray pilots on keeping the DDT out of the streams.

Fish kills reported to have occurred within or in the vicinity of the spray area were investigated and the cause of death determined as accurately as possible.

FINDINGS:

Although some stations were sampled on the East and West Forks and all of their tributaries within the spray areas, detailed discussion in this report will be limited to only the principle streams, on which the major portion of our survey effort was spent. These are: The East Fork of the Bitterroot River and two tributaries, Camp Creek and Warm Springs Creek, and the West Fork of the Bitterroot River and three tributaries, Slate Creek, Overwhich Creek and Hughes Creek. These were considered important fishing streams by the Forest Service and the Fish and Game Department, and spraying was not to be done closer than one-quarter mile from their edges. Spray patterns were not broken for the other, smaller streams in the area, and investigation on them consisted principally of drift sampling and/or direct observation following spraying. Dead insects were noted in all of such streams checked.

EAST FORK UNIT

Timbered areas along the East Fork of the Bitterroot and its tributary streams were sprayed commencing June 30 and ending July 8, 1959. Five stations were sampled in the East Fork; four of these stations were within the spray area and one station was one mile above the spray boundary. Figure 1 shows the locations of these sampling stations.

Figure 1. East Fork Unit.

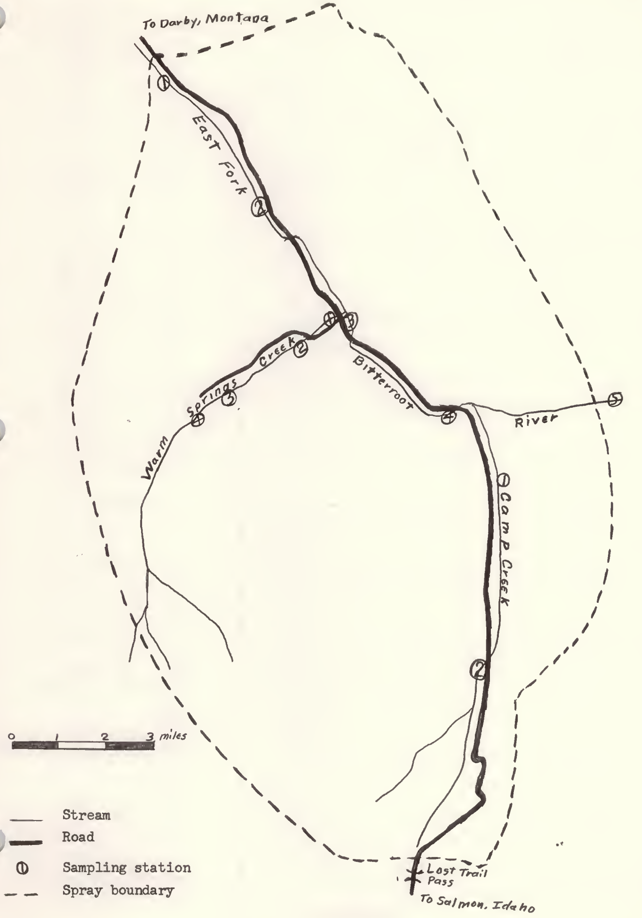


Table 1. Four-square-foot pre-spray and post-spray bottom samples collected from the East Fork of the Bitterroot River, during 1959.

Station	Date	Sample	Insects	No.	Volume
3	June 29	Pre-spray	Mayflies	103	1.2
			Trueflies	5	.1
			Stoneflies	9	1.0
			Others	9	.1
3	July 21	Post-spray	Mayflies	2	T
			Trueflies	8	.5
			Stoneflies	184	29.2
3	Sept. 17	Post-spray	Mayflies	33	.2
			Stoneflies	8	1.1
			Others	9	.3
4	June 30	Pre-spray	Mayflies	50	.1
			Trueflies	9	.2
			Stoneflies	11	2.2
			Others	1	T
4	July 21	Post-spray	Mayflies	39	.4
			Trueflies	33	1.0
			Stoneflies	8	2.0
			Others	5	.1
4	Sept. 17	Post-spray	Mayflies	66	.6
			Trueflies	51	.8
			Stoneflies	29	2.1
5	June 29	Control	Mayflies	21	.8
			Trueflies	3	T
			Stoneflies	1	T
5	July 21	Control	Mayflies	2	.1
			Trueflies	1	T
			Stoneflies	5	.3
5	Sept. 17	Control	Mayflies	89	.8
			Trueflies	19	.4
			Stoneflies	16	.3
			Others	2	T
1	July 21	Post-spray	Trueflies	1	T
			Stoneflies	132	20.3
1	Sept. 17	Post-spray	Mayflies	13	.2
			Trueflies	24	.2
			Stoneflies	106	15.3
			Others	6	.1
2	July 21	Post-spray	Mayflies	6	.2
			Trueflies	5	.2
			Stoneflies	158	18.6
2	Sept. 17	Post-spray	Mayflies	15	.1
			Trueflies	47	1.2
			Stoneflies	81	6.3
			Others	15	.3

Pre-spray bottom samples were taken at stations 3, 4, and 5. Post-spray bottom samples were taken at all stations. The results of these samples are given in Table 1. A comparison of these data indicate that little damage was done to the bottom fauna of the East Fork of the Bitterroot River. It may be noted from Table 1 that the numbers of mayflies decreased from the pre-spray to the post-spray samples at all stations where pre- and post-spray samples were taken. At those stations where no pre-spray bottom samples were taken, the mayflies were either absent or present in low numbers in the post-spray bottom samples.

Drift sample data collected from the East Fork at stations 1-4 show that the mayflies were the most numerous drifting insect present at the time of sampling. Station 5 was outside of the spray area and only one individual insect was taken in one drift sample. It is realized that many of the insects drifting in the East Fork may have originated from the tributary streams and not from the East Fork itself. The drift sample data for the East Fork stations are presented in Table 2.

Table 2. One minute pre-spray and during-spraying drift samples from stations 1-5, East Fork of the Bitterroot River.

Station	Date	Time	Insects	No.	Volume
1	June 25	Pre-spray	None	--	--
1	June 30	1030	Mayflies	1000's	--
			Trueflies	1000's	--
			Stoneflies	1000's	--
			Others	100's	--
2	July 3	0930	Mayflies	2	T
			Stoneflies	2	.5
			Others	1	T
3	June 29	Pre-spray	Mayflies	1	T
			Trueflies	2	T
3	July 2	1145	Mayflies	16	.1
			Stoneflies	4	.5
			Others	5	.1
3	July 3	0920	Mayflies	1	T
			Stoneflies	4	.1
4	June 30	Pre-spray	Mayflies	1	T
4	July 1	0915	Mayflies	86	.1
			Trueflies	6	T
			Stoneflies	1	T
			Other	2	T
4	July 1	1030	Mayflies	12	T
			Trueflies	1	T
4	July 2	0830	Mayflies	2	T
			Stoneflies	1	T
			Others	2	T
4	July 5	0950	Mayflies	1	T
4	July 7	1215	Mayflies	1	T
5	July 2	Control	Others	1	T

None of the DDT spray was observed to have drifted into the East Fork. The timber bordered the stream at only one place, a short distance upstream from station 3. The remainder of the stream shoreline was open and free of timber.

No fish kills were observed or reported in the area of the East Fork that was sprayed.

Camp Creek: Two sample stations were set up on Camp Creek, a small tributary of the East Fork. Figure 1 shows the sampling sites. Pre-spray drift and bottom samples were taken from station 1. Only post-spray bottom samples were taken from station 2. The summary of the pre- and post- bottom samples is given in Table 3.

Table 3. Four-square-foot pre-spray and post-spray bottom samples for stations 1 and 2, Camp Creek.

Station	Date	Sample	Insects	No.	Volume
1	June 30	Pre-spray	Mayflies	91	2.0
			Trueflies	1	.1
			Stoneflies	1	.1
			Other	4	.4
1	July 21	Post-spray	Mayflies	1	.1
			Stoneflies	2	.2
			Other	1	.1
1	Sept. 17	Post-spray	Mayflies	10	.1
			Trueflies	105	5.5
			Stoneflies	2	.3
2	July 21	Post-spray	Mayflies	62	5.0
			Stoneflies	1	.1
			Others	3	.3
2	Sept. 17	Post-spray	Mayflies	1	.1
			Trueflies	7	.1
			Stoneflies	4	.1
			Others	3	.4

Drift samples were taken at both stations when areas immediate to or above the station were sprayed. A summary of the pre-spray drift samples and during-spraying drift samples is given in Table 4.

From these data it is apparent that Camp Creek suffered a heavy insect kill. The spraying in the vicinity of Camp Creek station 1 took place July 1st and 2nd. The data for July 1st, in Table 4 show that the full impact of the DDT upon the insect life occurred some two hours after application, with a steady decrease thereafter.

The spraying of the headwaters of Camp Creek occurred July 7th. The drift samples from 0745 to 1045 hours indicate that very little DDT entered the stream. At approximately 1100 hours, a heavy rainstorm occurred. Drift samples taken after this rainstorm show a large increase in the number of insects collected. Apparently, the rain run-off may have washed additional DDT into the stream.

A large percentage of the insects killed were mayflies. A comparison of the bottom samples from station 1 indicate a decrease in the number of mayflies from the pre-spray sample to the post-spray sample.

No fish kills were reported or observed in Camp Creek.

The spray pilots were able to keep the DDT spray out of Camp Creek, above station 2, and if clear weather had followed the spray job, this portion of the stream may have suffered only very light damage.

Table 4. One minute pre-spray and during-spraying drift samples from station 1 and 2, Camp Creek.

Station	Date	Time	Insects	No.	Volume
1	June 30	Pre-spray	Mayflies	1	T
			Others	1	T
1	July 1	0645	Mayflies	12	.1
			Trueflies	1	T
			Stoneflies	2	.1
			Others	3	.2
1	July 1	0745	Mayflies	1000's	
			Trueflies	100's	
			Stoneflies	100's	
			Others	100's	
1	July 1	0930	Mayflies	99	.2
			Trueflies	10	T
			Stoneflies	2	T
			Others	2	T
1	July 2	1120	Mayflies	116	.2
			Others	3	.2
2	July 7	0745	Mayflies	22	.3
			Others	3	.2
2	July 7	0845	Mayflies	36	.4
			Stoneflies	11	.1
			Others	6	.2
2	July 7	1045	Mayflies	76	.7
			Stoneflies	3	.2
			Others	30	.8
2	July 7	1245	Mayflies	168	1.5
			Stoneflies	3	.2
			Others	27	.6
2	July 7	1415	Mayflies	149	2.3
			Stoneflies	5	.1
			Others	32	1.3

Warm Springs Creek: Three sampling sites were selected for Warm Springs Creek. A single drift sample and a post-spray bottom sample were taken at a fourth station and are given in Table 9.

Unlike the rest of the streams in the East Fork Unit, Warm Springs Creek, except for the lower one-half mile, was timbered down to the stream's edge. On one occasion a spray pilot forgot to shut off the spray when passing over the stream. On several other occasions, the spray would be shut off, but faulty shut-off valves would allow additional DDT to leak out while the plane was over the stream. Immediately following the spraying of June 30th an oil slick, indicating DDT spray, was observed in the stream, on automobiles parked by the stream, and in pans used to sort the drift samples.

Table 5 gives the data from the pre- and post-spray bottom samples. These data do not indicate any serious damage to the bottom fauna. It should be noted that the pre-spray bottom samples for stations 1 and 2 are poor and may not be indicative of the fauna present at that time.

Table 5. Four-square-foot pre-spray and post-spray bottom samples, stations 1, 2 and 3, Warm Springs Creek.

Station	Date	Sample	Insects	No.	Volume
1	June 25	Pre-spray	Mayflies	2	T
			Trueflies	1	T
1	July 21	Post-spray	Mayflies	2	.2
			Trueflies	2	.1
			Stoneflies	22	4.5
1	Sept. 17	Post-spray	Mayflies	7	T
			Trueflies	15	.2
			Stoneflies	29	.8
			Others	1	T
2	June 25	Pre-spray	Mayflies	1	T
2	July 21	Post-spray	Mayflies	25	1.3
			Stoneflies	2	.2
			Others	3	.1
2	Sept. 17	Post-spray	Stoneflies	26	.6
3	June 25	Pre-spray	Mayflies	15	.4
			Trueflies	1	T
			Stoneflies	1	T
			Others	1	T
3	July 3	Pre-spray	Mayflies	41	1.8
			Others	6	1.1
3	July 21	Post-spray	Mayflies	37	.4
			Stoneflies	2	.2
3	Sept. 17	Post-spray	Mayflies	2	T
			Trueflies	5	T
			Stoneflies	17	T

Table 6 gives the results of the drift samples taken during and following spraying of the forest area above station 1. Station 2 was also in the area sprayed and, therefore, was not sampled at this time. This area was sprayed the morning of June 20. The samples taken indicate a large kill occurred immediately following spraying, followed by a decrease within one-half hour. The sudden increase and decrease may have been the result of one spray plane making a pass over the creek a few hundred yards above the sampling site without turning the spray off.

Table 6. One minute drift samples collected from Station 1, Warm Springs Creek.

Date	Time	Insects	Number	Volume
June 30	0630	Mayflies	5	T
		Trueflies	1	T
		Stoneflies	2	T
June 30	0700	Mayflies	113	.8
		Trueflies	31	.3
		Stoneflies	232	5.2
		Others	187	3.6
June 30	0730	Mayflies	10	T
		Trueflies	33	.1
		Stoneflies	33	T
		Others	4	T
June 30	1245	Mayflies	27	.4
		Trueflies	6	T
		Stoneflies	7	.2
		Others	38	2.1
July 5	1330	Mayflies	20	.1
		Trueflies	4	T
		Stoneflies	1	T
		Others	10	.1
July 6	0845	Mayflies	278	3.8
		Trueflies	4	.1
		Stoneflies	42	2.3
		Others	62	1.8
July 6	1200	Mayflies	520	4.4
		Trueflies	20	.1
		Stoneflies	88	1.2
		Others	160	6.8
July 7	0630	Mayflies	34	.4
		Trueflies	6	.1
		Stoneflies	4	.1
		Others	12	.1
July 7	1230	Mayflies	3	.7
		Stoneflies	2	T
		Others	1	.1

Samples were taken at station 1 periodically throughout the time that the stream was subject to spraying. On July 5, an area upstream from station 2 and including station 3 was sprayed. Here again, the airplane pilots were not able to keep the DDT spray out of the stream. On July 6, an increase in the number of drifting insects was noted at station 1.

Tables 7 and 8 give the results of the drift samples taken at stations 2 and 3. These data show that a very severe insect kill occurred between these stations and above station 3 when this area was sprayed July 5. The one drift sample taken at station 4 (Table 9) also supports the data given in Tables 7 and 8. Mayflies, stoneflies, and caddisflies (others in tables) were affected most severely.

Table 7. One minute drift samples collected from Station 3, Warm Springs Creek.

Date	Time	Insects	Number	Volume
July 5	0715	Mayflies	14	.1
		Trueflies	5	T
		Stoneflies	4	T
		Others	2	T
July 5	0745	Mayflies	145	.7
		Trueflies	29	.3
		Stoneflies	64	.4
		Others	15	.2
July 5	0845	Mayflies	1266	8.4
		Trueflies	38	.2
		Stoneflies	146	2.0
		Others	228	1.4
July 5	0945	Mayflies	852	6.0
		Trueflies	38	.2
		Stoneflies	186	1.2
		Others	184	2.0
July 5	1045	Mayflies	722	6.2
		Trueflies	36	.2
		Stoneflies	106	1.4
		Others	140	1.3
July 5	1400	Mayflies	215	1.9
		Trueflies	13	.2
		Stoneflies	8	1.5
		Others	17	.5
July 6	0600	Mayflies	125	1.3
		Trueflies	2	T
		Stoneflies	15	.1
		Others	29	.7

Table 8. One minute drift samples collected from Station 2, Warm Springs Creek.

Date	Time	Insects	Number	Volume
July 5	1400	Mayflies	78	.7
		Trueflies	3	T
		Stoneflies	7	.1
		Others	15	.2
July 5	1445	Mayflies	101	.6
		Trueflies	4	T
		Stoneflies	6	.1
		Others	27	.5
July 6	0615	Mayflies	338	2.8
		Trueflies	6	.2
		Stoneflies	56	.8
		Others	95	3.5
July 6	0715	Mayflies	284	4.2
		Trueflies	4	.4
		Stoneflies	136	1.2
		Others	130	4.4
July 6	0815	Mayflies	500	6.4
		Trueflies	4	.1
		Stoneflies	84	1.3
		Others	208	5.8
July 6	0915	Mayflies	620	7.2
		Trueflies	6	.1
		Stoneflies	48	1.0
		Others	192	6.0
July 6	1115	Mayflies	514	7.8
		Stoneflies	170	3.4
		Others	160	6.4
July 6	1345	Mayflies	556	5.6
		Trueflies	8	T
		Stoneflies	100	.4
		Others	146	5.6
July 6	1515	Mayflies	190	1.8
		Stoneflies	32	.8
		Others	30	.6

Table 9. One minute drift sample and four-square-foot bottom sample, station 4, Warm Springs Creek.

Date	Time	Sample	Insects	No.	Volume
July 5	1200	Drift	Mayflies	512	5.0
			Trueflies	32	.4
			Stoneflies	44	.4
			Others	76	2.0
July 21		Bottom	Mayflies	10	.7
			Stoneflies	2	T

It is apparent from Table 7 that the greatest number of drifting insects at station 3 occurred between the hours of 0845 and 1045, July 5th. The greatest number of insects taken at station 2 occurred July 6th between 0615 and 1345 hours. An increase in the number of drifting insects was also noted for July 6th at station 1. One reason for the time delay between stations is that station 2 was three-quarters of a mile above station 1 and station 3 was one and three-quarters mile above station 2.

A fish kill occurring within the spray boundaries of this stream was brought to the attention of fishery personnel and was investigated immediately. It was determined that the trout population of a series of beaver ponds was heavily infected with a fungus, thought to be Saprolegnia. Conclusions concerning this fish kill were: (1) The small area involved did not warrant any special management measures of control or rehabilitation; (2) the most likely causal agent was the fungus; (3) DDT was not likely even a contributing factor in this kill.

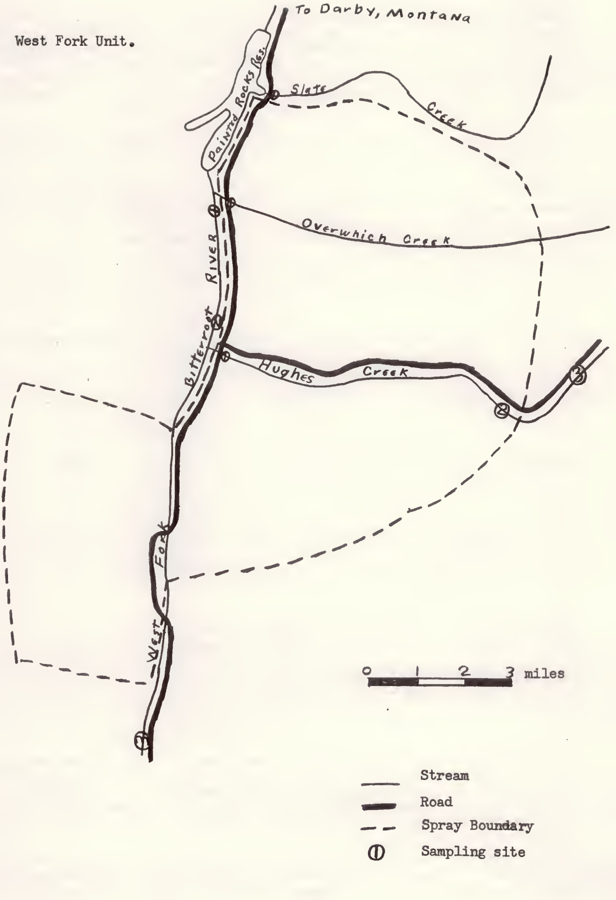
WEST FORK UNIT

West Fork of the Bitterroot River: Timbered areas within the West Fork Unit were sprayed from July 9 through July 16, 1959. Three stations were sampled in the West Fork. Stations 1 and 2 were within the spray area and station 3 was above the spray boundary. Figure 2 shows the locations of these sampling stations. Pre- and post-spray bottom samples were taken at all stations. The results of these bottom samples are given in Table 10.

Table 10. Four-square foot bottom samples, Stations 1, 2, and 3, West Fork of the Bitterroot River.

Station	Date	Sample	Insects	No.	Volume
1	July 3	Pre-spray	Mayflies	6	.2
			Trueflies	2	T
			Stoneflies	6	1.8
1	July 22	Post-spray	Stoneflies	10	3.6
			Others	2	.2
1	Sept. 25	Post-spray	Trueflies	11	T
			Stoneflies	3	1.5
2	June 29	Pre-spray	Mayflies	23	.5
			Trueflies	4	T
2	July 22	Post-spray	Stoneflies	4	T
2	Sept. 25	Post-spray	Trueflies	2	T
			Stoneflies	5	.2
3	June 29	Pre-spray	Mayflies	39	.4
			Stoneflies	4	.2
			Others	2	.1
3	July 22	Post-spray	Mayflies	19	.5
			Trueflies	1	T
			Stoneflies	2	.1
			Others	10	.3
3	Sept. 25	Post-spray	Mayflies	35	.2
			Trueflies	1	.3
			Stoneflies	22	.4
			Others	10	1.3

Figure 2. West Fork Unit.



A comparison of the bottom samples collected from stations 1 and 2 shows a reduction in the numbers of mayflies taken. The samples taken from station 3, the control, does not show this reduction. Drift samples taken at stations 1 and 2 indicate that a severe kill of mayflies occurred (Table 11). The stream between station 1 and station 2 and directly above station 2 received some DDT spray during the spraying operation. Spraying of this sector of the West Fork unit occurred the morning of July 9th.

Table 11. One-minute drift samples, stations 1 and 2, West Fork of the Bitterroot River.

Station	Date	Time	Insects	No.	Volume
1	July 9	0800	Mayflies	35	.1
			Stoneflies	4	.2
			Others	2	.1
1	July 9	1100	Mayflies	701	3.3
			Trueflies	4	T
			Stoneflies	23	.4
			Others	3	.2
1	July 9	1400	Mayflies	243	1.1
			Stoneflies	10	.5
			Others	4	.2
2	July 9	0830	Mayflies	192	1.1
			Trueflies	8	T
			Stoneflies	82	1.8
			Others	5	.2
2	July 9	1345	Mayflies	65	.3
			Trueflies	4	T
			Stoneflies	4	.1
			Others	1	T
2	July 11	1000	Mayflies	2	T
			Stoneflies	5	.2

Overwhich Creek: One station was sampled on Overwhich Creek. Figure 2 shows the site of this station. Pre- and post-spray bottom samples and drift samples were collected from this station. Tables 12 and 13 give the results of these collections. The first spraying of the timber near Overwhich Creek occurred July 9th and the second spraying on July 11th. Data from drift samples (Table 13) indicates insects were not affected much by the first spraying but a large number were killed by the July 11th spraying.

Generally, the stream bottom within the area sprayed July 9th was open, with very little timber close to the stream. The area sprayed July 11th included many places where dense stands of timber bordered the stream. The airplane pilots were able to keep the DDT out of the stream in areas where trees didn't extend to the stream shore, but were unable to keep the spray out of the stream where timber extended to the shoreline.

A comparison of the pre-and post-spray bottom samples indicate that an insect kill may have occurred in Overwhich Creek. Mayflies were the most abundant insect in the drift samples and were almost non-existant in the post-spray bottom samples.

Table 12. Four-square foot pre- and post-spray bottom samples from Overwhich Creek.

Date	Sample	Insects	No.	Volume
July 3	Pre-spray	Mayflies	5	.2
		Stoneflies	2	.8
July 22	Post-spray	Trueflies	1	.4
		Others	2	.2
Sept. 25	Post-spray	Mayflies	2	T
		Trueflies	7	T
		Stoneflies	3	T

Table 13. One minute drift samples collected from Overwhich Creek.

Date	Time	Insects	No.	Volume
July 9	0745	Mayflies	1	T
		Trueflies	12	.1
		Others	4	.1
July 9	1100	Others	1	T
July 11	0600	Mayflies	10	T
		Stoneflies	2	T
		Others	1	T
July 11	0700	Mayflies	121	.6
		Trueflies	2	T
		Stoneflies	22	.1
		Others	39	.2
July 11	0900	Mayflies	912	3.1
		Trueflies	4	T
		Stoneflies	50	.8
		Others	37	.3
July 11	1100	Mayflies	213	1.8
		Trueflies	2	T
		Stoneflies	12	.2
		Others	6	.2
July 11	1400	Mayflies	106	.6
		Trueflies	3	.1
		Stoneflies	9	.2
		Others	21	.5
July 12	0700	Mayflies	46	.2
		Trueflies	2	.1
		Stoneflies	8	.1
		Others	10	.7
July 12	1130	Mayflies	1	T
		Trueflies	1	T
		Others	2	T
July 13	0700	Mayflies	3	T
		Trueflies	1	.1
		Stoneflies	1	T
		Others	2	.1
July 13	0930	Others	1	.1

Hughes Creek: Three stations were sampled in Hughes Creek. These stations are shown in Figure 2. Station 3 was upstream from the spray boundary, the other stations were within the spray area. Pre- and post-spray bottom samples were taken at all stations. Drift samples were taken at stations 1 and 2 when areas were sprayed above the station. Table 14 gives the results of the pre- and post-spray bottom samples for all stations. Tables 15 and 16 give the drift sample data for stations 1 and 2.

Table 14. Four-square foot bottom samples, stations 1, 2, and 3, Hughes Creek.

Station	Date	Sample	Insects	No.	Volume
1	July 3	Pre-spray	Mayflies	11	.6
			Trueflies	1	T
			Stoneflies	6	1.0
			Others	2	.1
1	July 22	Post-spray	Mayflies	1	T
			Trueflies	1	T
			Stoneflies	21	3.1
			Others	1	T
1	Sept. 25	Post-spray	Mayflies	11	.1
			Trueflies	16	T
			Stoneflies	23	.7
			Others	1	T
2	July 3	Pre-spray	Mayflies	59	.6
			Trueflies	3	T
			Stoneflies	6	.4
			Others	3	.1
2	July 22	Post-spray	Mayflies	15	.3
			Trueflies	5	.6
			Stoneflies	19	1.2
			Others	7	.4
2	Sept. 25	Post-spray	Mayflies	172	2.1
			Trueflies	23	.2
			Stoneflies	46	1.3
			Others	66	.7
3	July 3	Pre-spray	Mayflies	53	.3
			Trueflies	6	.1
			Stoneflies	5	.1
			Others	5	.2
3	July 22	Post-spray	Mayflies	38	.5
			Stoneflies	4	.3
			Others	6	.4

A comparison of the bottom sample data given in Table 14 indicates that there was a temporary reduction in the numbers of mayflies present in Hughes Creek in the vicinity of stations 1 and 2. The post-spray bottom samples at these two sites shows a marked increase in the numbers of mayflies from July 22 to September 25. Samples collected from the control station show a decrease in numbers of insects found from the pre-spray to the post-spray bottom samples.

The area above station 1 was first sprayed July 11th. The drift samples for this day and for several days following are given in Table 15. Included in this table are two pre-spray drift samples taken on July 3 and July 9. These data show that this stream suffered some loss of insect life for the first day following spraying. The most numerous insects were the mayflies.

Table 15. One minute drift samples, station 1, Hughes Creek.

Date	Time	Insects	No.	Volume
July 3	Pre-spray	None		
July 9	Pre-spray	None		
July 11	0600	Mayflies	1	T
		Stoneflies	1	T
July 11	0700	Mayflies	36	.2
		Stoneflies	2	.1
		Others	4	.2
July 11	0800	Mayflies	128	.5
		Stoneflies	7	.1
		Others	5	.1
July 11	0900	Mayflies	316	1.1
		Trueflies	4	T
		Stoneflies	9	.4
		Others	14	.2
July 11	1000	Mayflies	320	.8
		Trueflies	6	.1
		Stoneflies	6	.1
		Others	10	.1
July 12	0900	Others	4	.1
July 13	0730	Others	4	.1
July 15	1545	Others	2	.1

Station 2 was about five miles upstream from station 1. The area around this station was sprayed July 15th. The drift sample data given in Table 16 indicate mayflies and caddisflies were the hardest hit by the DDT spray, although the damage was not thought to be severe.

Table 16. One minute drift samples, station 2, Hughes Creek.

Date	Time	Insects	No.	Volume
July 15	1100	Mayflies	83	.5
		Trueflies	1	T
		Stoneflies	2	T
		Others	14	.2
July 15	1200	Mayflies	90	.5
		Trueflies	2	T
		Stoneflies	1	T
		Others	19	.3
July 15	1615	Mayflies	62	.3
		Others	12	.3

Slate Creek: One station was sampled in Slate Creek. Figure 2 gives the location of this site. Pre- and post-spray drift and bottom samples were collected at this station. One pre-spray drift sample was also taken. Slate Creek was subjected to DDT on two separate days, July 11th and 13th. The July 11th spraying was not scheduled, but occurred when the airplane pilots sprayed the wrong area. Tables 17 and 18 give the results of these samples.

A comparison of the bottom samples indicates a reduction in the number and volume of insects from the pre-spray to the post-spray samples. This reduction is generally due to the decreased number of mayflies taken in these bottom samples. Note from Table 17 that the mayflies were the most abundant insect taken in the drift samples.

Table 17. One minute drift samples, Slate Creek.

Date	Time	Insects	No.	Volume
July 11	0620	Mayflies	3	.2
July 11	0720	Mayflies	1	T
		Trueflies	1	T
July 11	0930	Mayflies	16	.2
		Trueflies	20	.1
		Stoneflies	2	T
		Others	1	T
July 11	1130	Mayflies	12	.1
		Trueflies	2	T
July 11	1420	Mayflies	2	T
		Trueflies	1	T
July 12	0700	Mayflies	10	.1
		Trueflies	2	T
July 13	1630	Mayflies	100	.6
		Stoneflies	1	T
July 13	1800	Mayflies	135	1.1
		Others	21	.6
July 13	1930	Mayflies	63	.5
		Trueflies	1	.1
		Stoneflies	1	T
		Others	18	.7
July 14	0930	Mayflies	6	.1
		Stoneflies	1	T
		Others	6	.1
July 14	1500	Mayflies	2	T
		Trueflies	1	T
		Others	1	T

Table 18. Four-square foot bottom samples from Slate Creek.

Date	Sample	Insects	No.	Volume
July 3	Pre-spray	Mayflies	33	1.9
		Trueflies	2	T
		Others	2	T
July 22	Post-spray	Mayflies	7	.3
		Stoneflies	1	T
Sept. 25	Post-spray	Mayflies	5	T
		Trueflies	1	.3
		Stoneflies	12	T
		Others	1	T

An oil slick was noticed on the surface of Painted Rocks Reservoir (Figure 2) following the July 13th spraying of Slate Creek. On the evening of the same day, dead and dying fish were observed along the shoreline of this reservoir in the vicinity of the mouth of Slate Creek (Figure 2). Fish species observed dead or in distress included suckers, whitefish, rainbow trout, and eastern brook trout. The most numerous fish were the suckers and whitefish. Concentrations observed the evening of July 13 approached one dead or distressed fish per one-foot of shoreline. Observation July 14th in the same area showed a concentration of one dead fish per 100 feet of shoreline and for an area across the lake a concentration of one dead fish per 1000 feet of shoreline.

A report of dead fish being found along the shoreline before the spraying occurred was investigated. Mr. Westover, a Forest Service engineer residing on the lake, reported seeing several dead suckers on the lake shore several days before the spraying. He attributed this to a severe wind storm.

The report of dead fish before the spraying casts doubt as to the causal agent of the die-off. However, the only unusual factor known to be present during the mortality in the vicinity of the mouth of Slate Creek was the application of the DDT spray.

Additional observations by District 2 personnel indicate that this kill did not have any immediate, severe effect upon the game fish population of Painted Rocks Reservoir.

CONCLUSIONS:

East Fork Unit: Bottom samples taken from the East Fork of the Bitterroot River indicate that little damage was done to the bottom fauna of this stream. Camp Creek and Warm Springs Creek suffered large insect kills immediately following the application of the DDT spray. The drift samples showed that the mayflies were the most susceptible insects. Post-spray bottom samples, taken 2 1/2 months after spraying, indicated that these streams were recovering.

One fish kill was investigated that occurred within the spray boundaries of the East Fork Unit. This investigation showed that dead and moribund fish were heavily infected with a fungus (thought to be Saprolegnia) and that DDT was not a likely contributing factor to the kill.

West Fork Unit: Samples collected from the West Fork of the Bitterroot River indicate that the mayfly population was materially reduced for a short period following spraying, but had partially recovered by the time of the last sampling, September 25, 1959. Overwhich Creek, Hughes Creek, and Slate Creek also had large numbers of mayflies killed, but were partially re-populated by September 25th. None of the other insects in any of the principle streams were severely effected.

One fish kill occurred in the West Fork Unit, which could be associated with the spray operation. This kill occurred in Painted Rocks Reservoir. Fish mortality was heaviest near the mouth of Slate Creek but extended all around the shoreline of the lake. Conflicting reports concerning the actual beginning of this kill cause doubt as to its most probable cause. However, the only unusual factor known to be present at the time of the largest die-off was the application of the DDT spray. Positive determination of the causal agent was beyond the scope of this project, which was limited to determining whether or not it had any immediate fishery management importance. It did not.

In general, the streams or sections of streams that were timbered down to the water's edge suffered a larger insect kill than those that were free from timber. In the former instances, the spray pilots were not able to keep the spray from being blown or drifting into the stream. In another case, a heavy rain is thought to have washed DDT into a stream, changing a light insect kill into a severe kill.

Usually, the duration of the insect kills was relatively short-lived. Most of the drifting insects had passed the sample stations within four hours after the spraying was completed. The most susceptible insects were the mayflies, followed by the caddisflies in streams where the latter were found in large numbers.

Much of the DDT reaching the streams resulted from leaky shut-off valves on the spray tanks, from pilots spraying too close to the stream or lake banks, or from adverse weather conditions.

RECOMMENDATIONS:

A. Procedure

1. Spray pilots and Forest entomologists should be more firmly instructed to leave an unsprayed strip along stream and lake shores.

2. Spray equipment should be in such order that dripping shut-off valves do not occur.

3. Spray pilots should be instructed to refrain from making steep, banking turns over streams and lakes, wherever possible.

B. Investigation

1. A fishery management investigation should be made of future spray operations. The objectives should be:

   a. To locate areas of fishery damage and determine what special management measures, if any, may be necessary.

b. To observe the techniques of the spray application and make suggestions for minimizing its effects on the aquatic habitat, wherever possible.

c. To investigate any fish kills which may occur coincident with the spray project, and to determine the most likely cause(s) of each kill, where possible.

2. Insect sampling should be limited to the important fishing waters within the spray boundary.

3. Some aerial observations of the spray application should be made. Radio contact between the airplane employed for such observations and the ground crew is very desirable.

Prepared by: Joe E. Huston

Date: June 20, 1960

Approved by: George D. Holton

Date: Sept. 15, 1960

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JOB COMPLETION REPORT

INVESTIGATIONS PROJECT

State of Montana

Project No. F-12-R-6 Name Western Montana Fishery Study

Job No. I Title Inventory of Waters of the Project Area

Period Covered May 1, 1959 - April 30, 1960

ABSTRACT:

Twenty-five streams and fifteen lakes were surveyed during the summer of 1959. Locations of waters, population sampling effort, fish captured, and age and growth data are recorded in the district and Helena lake and stream survey files. These data are presented in tabular form for the waters for which specific management recommendations are made.

The results of the investigation of the effects of the U.S. Forest Service spruce budworm control program on aquatic life will be covered in a supplemental report.

OBJECTIVES:

To catalog some of the waters of the project area and to determine their value to the overall fishery management picture. The stream survey consisted of five parts: first, to catalog and determine the fishery value of the tributaries of Rock Creek within the Rock Creek Creel Census Study Area; second, to survey streams where requests for management of some type arose during the period covered by this report; third, to sample the population of a small stream that has been closed to fishing for several years; fourth, to survey outlet streams of the mountain lakes that were surveyed; and fifth, a continuation of a population inventory of the Little Blackfoot River to determine the effects of the cessation of a brown trout (Salmo trutta) planting program.

The objective of the high mountain lake survey was to determine the gross physical, chemical, and biological characteristics of each body of water. From the information gathered, previous management practices could be evaluated and future management recommendations made.

STREAM SURVEY:

Techniques Used:

Nineteen tributary streams of Rock Creek within the Rock Creek Creel Census Study Area were surveyed during June, 1959. One or more sections of each stream was sampled by electrofishing with a 220-volt A.C. generator. Shocked fish were captured with dip nets. Weights, total lengths, and species were recorded for each fish. Scale samples for age and growth data were taken only from streams that received fishing pressure, as denoted by the Rock Creek Creel Census Study. Other physical features of each stream were recorded on the Montana Fish and Game Department's standard stream survey form. Fisherman use was determined from the Rock Creek Creel Census data.

PLEASE RETURN

Acting on a request for hatchery trout, Ninemile Creek was surveyed. Three sections, comprising 850 feet of the stream, were electrofished. Fish captured were recorded by length, weight, and species. Other features of the stream were noted and recorded on the Montana Fish and Game Department's standard stream survey form.

Miller Creek, a small stream on the outskirts of Missoula, was sampled by electrofishing to determine the population level of a water that had been closed to fishing for several years. Two sections, comprising 425 feet, were fished. Fish collected were recorded by species, length, and weight. Scale samples were taken and forwarded to the department's fishery laboratory for age and growth analysis.

Three streams, Tin Cup Creek, Boulder Creek, and Ringeye Creek, were surveyed in conjunction with the mountain lake surveys. Only the gross physical factors, in addition to visual observations of fish life, were recorded on the stream survey form for each of these streams.

Seventeen 300-foot sample sections were electrofished in a 37-mile stretch of the Little Blackfoot River between Garrison, Montana and 15 miles upstream from Elliston, Montana. The four uppermost sample sections were electrofished with a 220-volt A. C. shocker, the remaining sections with a 220-volt D. C. shocker. Each section was blocked off with a net at the lower end and an electrical seine at the upper end. The section was further divided into two sub-sections, by placing a block net in the middle of the 300-foot section. Each sub-section was worked until all, or nearly all, fish were captured. All of the fish were recorded by length, weight, and species. Scale samples were taken from a representative sample of the whitefish and trout, and were forwarded to the department's fishery laboratory for age and growth analysis.

All twelve lower sections were electrofished during 1956 and 1959. Two of these 12 sections were omitted in 1957; one being completely de-watered by irrigation demands and the other dropped because of time limitations. A statistical comparison of the three years' catch data has been made for the lower twelve sections. The uppermost five sections were first electrofished in 1959.

Findings:

Of the streams surveyed in the Rock Creek Creel Census Study Area, six streams were found to contribute to the Rock Creek fishery. Seven additional streams were found to contain fish populations, but did not contribute to the Rock Creek fishery. Six streams were found to be ephemeral and of no fishery value.

The survey of Ninemile Creek showed that there were low numbers of catchable-size trout. Apparently, this stream's production and/or reproduction cannot keep up with the adult removal by fishermen and other causes. Possible contributing factors could be: (1) impaired spawning success due to siltation from an old dredge mine on this creek; (2) impaired natural productivity from the same cause; (3) low basic productivity of the stream.

Since old-timers report good fishing in this area before the dredge mining operation, and further, since even small-sized fish were scarce in our samples, we believe factor No. 1 above is the most likely cause.

The survey of Miller Creek, a stream closed to fishing, showed an abundant population of cutthroat trout and brook trout were present. Many of the fish captured were of a catchable-size, six inches or longer in length.

Table 1 gives a summary of the results of the surveys of Ninemile and Miller Creeks.

Figure 1 shows a comparison of the numbers of cutthroat trout, eastern brook trout, and whitefish taken from these streams. No whitefish were taken in Miller Creek. Numbers of fish are grouped by two-inch length intervals and have been computed by 100 feet of stream in order to make the data more readily comparable between the two streams. Note from Table 1 that Ninemile Creek has twice the flow of Miller Creek. Thus, if the numbers of fish per 100 feet of stream could be equitably adjusted to the difference in stream sizes, Figure 1 would show an even more marked difference between the populations of the two streams.

The statistical analysis of the Little Blackfoot River population inventory for the years 1956, 1957, and 1959 is presented in Table 2. Confidence limits for the average number of fish taken per section for each year and for each species are given. The confidence limits are given for all species of fish at the 80 percent level and also for brown trout and whitefish at the 95 percent level.

These statistics indicate a reduction in the average number of whitefish and brown trout per section from 1956 and 1957 to 1959 at the 80 percent confidence level. At the 95 percent level of confidence, there was a significant reduction in the number of brown trout per section from 1956 and 1957 to 1959.

Table 1. Summary of survey data from Miller Creek and Ninemile Creek.

Stream	Location	Flow cfs	Length Sampled	Species* Collected	Number Collected
Ninemile	T15N R23W Sec. 28 Missoula Co.	20±	850 ft.	Wf Ct Eb DV	14 46 14 1
Miller	T12N R20W Sec. 14 Missoula Co.	10±	425 ft.	Ct Eb	54 130

* The abbreviations are: Wf - whitefish; Ct - cutthroat trout; Eb - eastern brook trout; DV - Dolly Varden trout.

Recommendations:

1. The remaining tributaries of Rock Creek within the Rock Creek Creel Census Study Area should be surveyed as soon as possible.

2. Ninemile Creek should be placed on a planting schedule as an experimental stream. Two thousand 2-3 inch cutthroat trout should be planted within the vicinity of the Thisted Ranch for three years. The same three study sections should be inventoried each year to determine the effects of these plantings.

3. The Little Blackfoot River population inventory should be conducted again in 1961.

Figure 1. Number of fish by two-inch length intervals per 100 feet of stream, Miller Creek and Ninemile Creek.

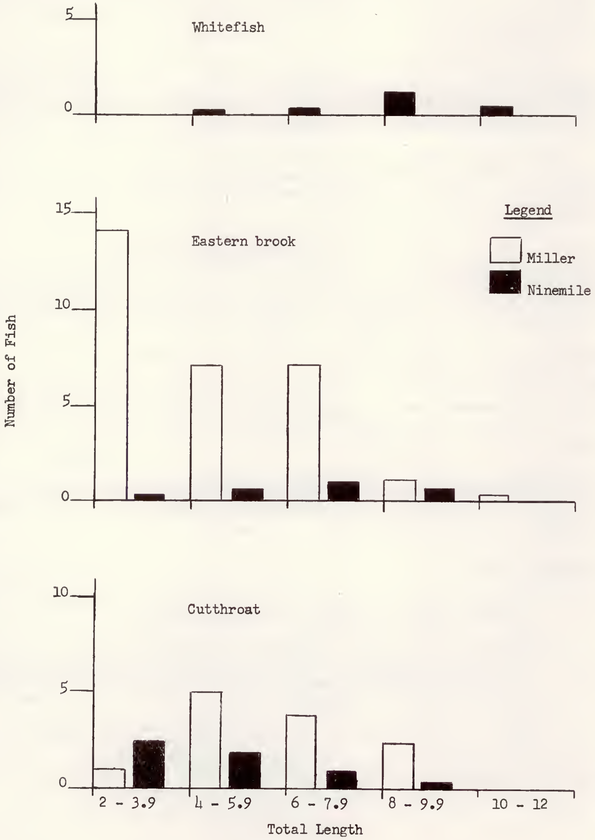


Table 2. Average catch per section from the Little Blackfoot River for the years of 1956, 1957, and 1959 with confidence limits of 80 and 95 percent.

Species	Year	Mean 80% Limits	Mean 95% Limits
Brown trout	1956	77.0 60.6 - 93.4	77.0 51.0 - 103.0
	1957	87.4 62.9 - 111.9	87.4 46.6 - 127.4
	1959	33.7 25.9 - 41.5	33.7 21.2 - 46.2
Whitefish	1956	97.0 65.5 - 128.5	97.0 46.0 - 148.0
	1957	89.0 62.1 - 115.9	89.0 45.0 - 133.0
	1959	46.0 35.4 - 56.6	46.0 29.0 - 63.0
Cutthroat trout	1956	4.2 0.0 - 8.7	
	1957	1.0 0.2 - 1.8	
	1959	5.0 0.0 - 10.3	
Rainbow trout	1956	0.2 0.1 - 0.3	
	1957	0.7 0.3 - 1.1	
	1959	0.4 0.0 - 0.8	
Eastern brook trout	1956	1.8 0.5 - 3.1	
	1957	2.4 0.7 - 4.1	
	1959	2.8 0.0 - 6.2	
Suckers	1956	4.0 1.7 - 6.3	
	1957	7.5 1.0 - 14.0	
	1959	3.4 1.0 - 6.8	
Dace	1956	6.4 0.5 - 12.3	
	1957	6.2 0.9 - 11.5	
	1959	4.6 0.3 - 8.9	
Sculpins	1956	42.0 29.4 - 54.6	
	1957	98.3 50.7 - 145.9	
	1959	36.0 16.5 - 55.5	

LAKE SURVEY

Techniques Used:

During August and September, 1959, 15 high mountain lakes were surveyed by project personnel. All were accessible only by 4-wheel drive vehicles or by pack stock. Nine of the lakes are in the Bitterroot River drainage, three are in the Blackfoot River drainage, and three are in the Clark Fork River drainage.

Prior to the ground survey, aerial photographs were taken of all lakes to be surveyed (with two exceptions). Maps were drawn from these photographs. Depths, contours, aquatic plant beds, inlets, outlets, and other important physical factors were recorded on these maps. Lake acreages were planimetered from the aerial photos, for which scale determinations had been made by ground measurements. Sketch maps, containing the same information were drawn for the two lakes not photographed and their acreages were estimated.

The lakes were gill netted with 125-foot graduated gill nets with five mesh sizes of 3/4" to 2" bar-measure. The nets were fished from 24 to 48 hours in each lake. Fish collected were recorded by length, weight, and species. Scale samples were taken from all fish. The scale samples from four lakes were sent to the department's fishery laboratory for age and growth analysis; the remainder were analyzed by project personnel.

The data gathered from each lake were recorded on Montana Fish and Game standard lake survey forms.

Findings:

Table 3 lists the 15 mountain lakes surveyed during 1959. Their location, size, and a summary of the net catch data are given. Age and growth data are given for the lakes in Tables 4a and 4b.

Two of the nine lakes surveyed in the Bitterroot River drainage, and two of the three lakes in the Clark Fork River drainage are impounded for irrigation. Two of the three lakes surveyed in the Blackfoot River drainage are impounded by beaver dams in their outlets.

Three of the 14 lakes surveyed were sterile of fish life. The remaining lakes contained populations of cutthroat trout, with one (Heart Lake) containing a combination of cutthroat trout and grayling.

Upper Elliot Lake was surveyed as part of an investigation of the probable effects upon the fish population of a proposed raising of the impoundment structure an additional two feet. Lower Elliot Lake, also impounded, was surveyed at the same time. The age and growth data and net-catch data is presented in Tables 3 and 4a and shows that fish growth is slow for both lakes. It was concluded that an additional two feet fluctuation in an already fluctuating lake would compound the ills already present in Upper Elliot Lake.

A comparison of the age and growth data and net-catch data for the lakes surveyed in the Bitterroot River drainage is given in Tables 3 and 4a. The basic productivity of all of these Bitterroot lakes is low. From these data it was concluded that Crystal Lake is the only lake that needs a planting of hatchery trout in the immediate future to maintain trout fishing.

The data from Heart Lake in the Blackfoot River drainage is also presented in Tables 3, 4a, and 4b. These data indicate a lake that contains a fast growing fish population. It was found that spawning facilities were very limited and it is recommended that this lake be planted with both grayling and cutthroat trout.

Recommendations:

1. Howard's Lake, in the Bitterroot River drainage, should be planted with cutthroat trout on an experimental basis. It is suspected that these fish will winter-kill, but the information gained should be useful in the management of fish in lakes similar to Howard's Lake.

2. Only two lakes, Crystal Lake in the Bitterroot drainage and Heart Lake in the Blackfoot drainage, are recommended for planting at this time. All of the lakes surveyed in the Bitterroot drainage should be planted only once every four or five years, because they have low fishing pressure due to poor accessibility.

3. The three lakes surveyed in the Clark Fork drainage are not recommended for planting at this time. It was recommended to the U.S. Forest Service that raising the dam on Upper Elliot Lake would be harmful to the future fish production of this lake.

4. No lake should be added to the planting program without first being surveyed.

5. Lakes that are impounded should either be surveyed during the time of greatest drawdown, or re-checked again at that time.

Prepared by Joe E. Huston   Approved by George D. Holton

Date May 17, 1960

Table 3. List of high mountain lakes surveyed.

Lake and Drainage[1]		Location	Size (acres)	Net sets and hours	Species[2] Collected	Number Collected
Boulder[3]	3	T1N R23W S1 Ravalli Co.	20.0	4 92	Ct	33
Crystal	3	T1N R23W S6 Ravalli Co.	8.4	2 90	Ct	5
Dollar	3	T1N R23W S6 Ravalli Co.	5.0	Hook & line 8	Ct	30
Howard's	3	T11N R22W S28 Missoula Co.	1.8	2 96	No fish taken	
Piquette	3	T1S R21W S20 Ravalli Co.	6.5	2 52	Ct	13
Shelf	3	T1S R21W S20 Ravalli Co.	10.4	2 42	Ct	13
Slate	3	T1S R21W S22 Ravalli Co.	4.7	2 80	No fish taken	
Turbid	3	T1N R23W S6 Ravalli Co.	10.0	2 90	No fish taken	
Tin Cup[3]	3	T2N R23W S1 Ravalli Co.	127.0	-- --	(Reported by F.S. trail crew Ct	
Heart	4	T16N R8W S17 Lewis & Clark Co.	32.0	4 88	Gr Ct	10 4
Parker	4	T16N R9W S9 Lewis & Clark Co.	12.3	4 85	Ct	86
Webb	4	T16N R9W S14 Lewis & Clark Co.	10.0(est)	2 26	Ct	31
Elliot, Lower[3]	5	T7N R11W S10 Powell Co.	31.0	2 32	Ct	77
Elliot, Upper[3]	5	T7N R11W S21 Powell Co.	67.0	2 41	Ct	96
Medicine	5	T4N R17W S2 Granite Co.	45.0(est)	3 60	Ct	28

1 Drainages are coded to conform with the statewide breakdown. 3 is the Bitterroot drainage, 4 is the Blackfoot drainage, and 5 is the Clark Fork drainage above the mouth of the Bitterroot.
2 Abbreviations are: Ct - cutthroat trout, Gr - grayling.
3 Lakes impounded for irrigation.

Table 4a. Age and growth of cutthroat trout from 11 lakes.

Lake and Drainage*		Length in Inches at Annulus I	II	III	IV	V	VI
Boulder	3	4.2"(32)**	8.1(31)	11.6(20)	15.0(4)		
Crystal	3	4.5(5)	7.3(4)	9.4(4)	11.8(3)		
Dollar	3	3.4(16)	7.4(16)	10.4(13)			
Piquette	3	3.2(11)	5.5(11)	7.2(11)	8.7(11)	10.2(7)	11.2(1)
Shelf	3	4.3(13)	9.0(13)	11.2(11)	12.8(4)		
Heart	4	4.9(4)					
Parker	4	3.0(58)	6.7(57)	10.2(39)	12.7(1)	17.2(1)	
Webb	4	3.3(31)	7.6(31)	10.0(16)	13.5(7)		
Elliot, Lower	5	2.8(23)	5.1(23)	6.8(16)	8.5(3)		
Elliot, Upper	5	2.7(49)	4.9(49)	6.6(25)	8.8(2)		
Medicine	5	4.9(28)	8.5(21)	11.6(8)			

Table 4b. Age and growth of grayling from Heart Lake.

Lake and Drainage*		Length in Inches at Annulus I	II	III	IV	V	VI
Heart	4	4.7"(10)**	11.3(10)	13.9(9)	15.0(8)	16.2(4)	

* Code for drainage is: 1 - Bitterroot, 2 - Clark Fork above the mouth of the Bitterroot, 3 - Blackfoot.
** Figures in parenthesis denote sample size.

Pages 2 & 3 and Table 1 (page 12) Corrected
5 Dec. 60 [illegible]

FISHERY DIST. #2
HIGHWAY 93 SOUTH
MISSOULA, MONTANA

MONTANA DEPARTMENT OF FISH AND GAME
FEDERAL AID IN FISH RESTORATION SECTION
HELENA, MONTANA

JOB COMPLETION REPORT
INVESTIGATIONS PROJECTS

State of Montana

Name Western Montana Fishery Study

Project No. F-12-R-5

Title Georgetown Lake Study

Job No. III

Period Covered May 1, 1958 - April 30, 1959

Abstract:

A creel census was conducted on Georgetown Lake during the summer angling season of 1958 and the winter angling season of 1958-59. The primary objective of this census was to obtain catch and effort information for better management of this popular fishing lake.

Total estimated pressure and catch for the summer and winter seasons and the methods used in computing those estimates are presented.

Recommendations are made to continue the census with some changes in techniques, to obtain closer supervision of the census technicians, and to mark portions of future trout plants in the lake.

Objectives:

Georgetown Lake is one of the most popular and perhaps the most productive mountain lake in western Montana. Its area is 2,800 acres and the lake is located about mid-way between the towns of Anaconda and Philipsburg, Montana.

Past management practices used on Georgetown Lake have consisted of: (1) planting various species and sizes of game fish; (2) opening the summer season one month later and closing it one month earlier than the general trout season; and (3) opening a winter season from mid-December until March 1, on Saturdays, Sundays and legal holidays. At various times since 1912, Georgetown Lake has been managed for rainbow trout, cutthroat trout, grayling, and a cutthroat-grayling combination. Eastern brook trout and silver salmon have also been stocked. Since 1955, the lake has been managed primarily for cutthroat trout. The above management practices have been based upon information taken from spawn trap records, statewide warden creel census and angler reports and also upon the needs of the statewide spawn taking operations.

Information from these sources indicates that: (1) there is a decrease in the individual size of the cutthroat trout in the spawning run during the past five years; (2) angler success has decreased during the same period; (3) angler success is higher during the winter season than during the summer season; and (4) anglers are generally dissatisfied with the present cutthroat management of the lake.

In that no tally of numbers of fish in each spawning run has been kept, and the statewide creel census has given very light coverage to this lake, the cause of these apparent decreases in fish size and fishing success cannot be determined. It was, therefore, apparent that much more detailed information than is now available would be necessary to manage this popular fishing lake successfully in the future.

Prior to the opening of the summer trout season on Georgetown Lake (June 29, 1958) an intensive creel census was designed. The objectives of this census were to collect the following information during both the summer and winter angling seasons.

1. Annual estimated total catch of fish from the lake, by species, in both numbers and pounds.
2. Total annual fishing pressure on the lake.
3. Comparative data between the summer and winter angling seasons in regard to catch, species composition, and fishing pressure.

Techniques Used:

The Georgetown Lake summer creel census began on June 29, 1958 and ended on October 31, 1958. Throughout this 125-day period a creel census technician counted boats and checked angler catches 30 weekend and holiday days, and 38 week days. Table 1 shows the days censused during each period of the summer season.

Census days were divided into a.m. and p.m. days. From June 29 through July 26 (first period) the a.m. check hours were from 0600-1600 and the p.m. check hours were from 1200-2200. Boat counts were made every two hours during this period, commencing at the starting hour for both a.m. and p.m. days.

From July 27 through September 21 (second period and part of the third period) the a.m. check hours were from 0800-1700 and the p.m. check hours were from 1100-2200. During this period, boat counts were made every three hours, commencing at the starting hour for both a.m. and p.m. check days.

Due to fewer daylight hours, the a.m. and p.m. division of census days was discontinued from September 22 to October 31 (part of the third period and fourth period). An all day check, from 0800-1700 was in effect during this period. Boat counts were made every three hours and angler contacts were made from 1200 until dark.

The census technician used a 12 foot boat, powered by a 15 h.p. outboard motor, to make the periodic boat counts. The number of boats counted, along with the count hour, was recorded on a boat count form.

Between boat count periods, the census technician would endeavor to contact as many boat parties as possible who had completed their fishing trip. Upon contacting a party, the following information was recorded:

1. Number of anglers in boat party.
2. Length of time party had been fishing.
3. Number of man-hours party had fished (ascertained from number of fishermen in party times hours party had fished).
4. Number of fish by species which the party had caught.

When time permitted, the census technician would obtain total weight by species of all fish in the catch. All the above information was recorded on a creel census form, a sample of which is shown on Figure 7.

From December 14, 1958 through March 1, 1959 the winter angling season was open on Georgetown Lake during Saturdays, Sundays and legal holidays. Table 2 lists the days the lake was checked during the winter season.

On the opening day of the winter angling season (December 14), an attempt was made to count all fishermen and "ice" houses on the lake, every three hours. Fishermen contacted were recorded as "house" or "open ice" anglers and from this record an average number of anglers per house was obtained. This method was feasable only on opening day, when all houses were occupied. On all following days, a periodic car count every three hours was used for estimating total pressure by the same method used with boat counts in the summer census.

In order to insure better coverage during the peak of the winter season, the lake was divided into three areas of responsibility. These are shown on Figure 1.

One census technician was assigned to each of these areas and instructed to make car counts every three hours, and to contact as many angler parties as possible, who had completed their angling trips.

Information recorded was the same as that taken during the summer season.

The winter season was divided into three periods. These were: December 14 to December 31, 1958; January 1 to January 31, 1959; and February 1 to March 1, 1959.

In addition to car counts, and angler contacts, one census technician was assigned the job of taking total weights by species of as many fish as possible. This job was assigned to a different area of responsibility each census day, so as to insure catch weight data from all areas of the lake.

During the summer of 1958, 133,121 cutthroat trout and 150,898 rainbow trout (three inches in length or longer) were planted in Georgetown Lake. One-third of the fish of each species were marked by removing the right premaxillary bone. Census technicians were informed of these marked fish and were instructed to record them separately on the creel census form. Total pressure and catch estimates were computed similar to the method described by Moyle and Franklin (1955).

Census data taken on Saturdays, Sundays and legal holidays were computed separately from weekday check data because of the increased angling pressure on the former.

During the first, second, and most of the third period of the summer census, an overlap period was present each day censused. Boats counted during this overlap period were used to estimate boats present during the p.m. period of the a.m. census days and the a.m. period of the p.m. census days.

An example of how this computation was carried out is as follows: From July 27 until August 23, there were four a.m. weekend days censused, and four p.m. weekend days censused. Boats counted during the a.m. sections of this period were listed under three columns as (1) boats counted in overlap period; (2) boats counted in non-overlap period; and (3) total boats counted for the entire period (the sum of 1 and 2). Boats counted during the p.m. days of this period were arranged in the same order.

After arranging the boat counts in this order for both a.m. and p.m. census days, the following step by step method of computation was used. Week days and weekend days were treated separately.

1. Both a.m. and p.m. columns of boats counted in overlap and total boats contacted were totaled. The sum of the total boats counted column was divided by the sum of the total boats in the overlap column for both a.m. and p.m. check days. The quotient thus determined from the p.m. days was used to estimate the total boat count for the a.m. days. The quotient for the a.m. days was used to estimate the total boat count for the p.m. days.

2. The above quotient was used as a constant in determining estimated boats for each individual a.m. and p.m. day. This constant was multiplied by the boats counted in the overlap period for the individual day under consideration. Then this product was added to the number of boats in the non-overlap period for the day. The sum of these two numbers gave the estimated total boat count for the day.

3. Next, the total boat hours were tallied from the census sheet. These boat hours were obtained from actual contacts made by the census technician, and consisted only of completed boat trips.

4. After the total boat hours were obtained, the average length of trip was determined. This was the quotient obtained by dividing the total boat hours by the total boats contacted during the particular day under consideration.

5. After determining the average length of trip, the boat "turnover" quotient was computed. That is, the theoretical number of times during the census day that one group of boats leaves the lake, and another group of boats takes their place. This quotient was determined by dividing the number of angling hours per day (17 hours in Montana) by the average length of trip.

6. Next, the average number of boats per count was computed. This was obtained by dividing the estimated total boat count (from Step 2) by the total number of boat counts that would have been made on a complete census day.

7. The average number of boats per count quotient was then multiplied by the boat "turnover" quotient. This product was the total estimated number of boat trips for the census day.

Following is an algebraic description of the methods used for the expansion of a.m. and p.m. boat count and contact data to full day boat trip estimates, for each individual census days of one period:

Where:

A = Individual a.m. day boat count.
B = Number of boats in A counted during overlap period.
C = A - B.
P = Individual p.m. day boat count.
Q = Number of boats in P counted during overlap period.
R = P - Q.

Then:

$$\frac{\sum A}{\sum B} \cdot Q + R = \text{Estimated total boat count for individual p.m. day } (E_{BC})$$

and

$$\frac{\sum P}{\sum Q} \cdot B + C = \text{Estimated total boat count for individual a.m. day } (E_{BC})$$

And where:

H = Number of hours in fishing day.
N = Number of boat counts which would have been made in a full day (not a.m. or p.m.).
L = Average length of trip (from contact data).

Then:

$$\frac{E_{BC}}{N} \cdot \frac{H}{L} = \text{Estimated total boat trips for one individual day } (E_{BT})$$

8. After determining the estimated total boat trips for the day, it was necessary to have a constant to proportionately increase the catch by species, fishermen, and fishermen hours. This constant was obtained by dividing the total estimated boats for the census day by the total boats contacted during the census day. This constant was then multiplied by the total fish checked (by species), fishermen contacted, and fishermen hours for the census day.

9. After the above estimate was made, the number of fishermen contacted was divided by the number of estimated fishermen. This quotient, multiplied by 100, gave the percent contact for the census day.

10. After estimates for each a.m. and p.m. day checked during the period were computed, it was then necessary to estimate the total boats, catch by species, fishermen and fishermen hours for the period concerned. This was accomplished by totaling the individual estimates for all days censused during the period, both a.m. and p.m. Next, the number of days in the period was divided by the number of days (both a.m. and p.m.) that were censused during the period. This quotient was then multiplied by the total number of estimated boats, catch by species, fishermen, and fishermen hours for the days censused. The products thus obtained were considered the total estimated boats, catch, fishermen and fishermen hours for the period concerned. The percent contact for the period was obtained by dividing the total boats contacted by the estimated total boats, and multiplying this quotient by 100.

On opening day (June 29), with from 3 to 9 census takers contacting anglers, contacts exceeded 40 percent of the total estimated fishermen. On the following days, with one census technician working, contacts ranged from 5 to 15 percent. The opening day's contact data, because this day's fishing pressure was markedly higher than any other censused day of the season, was not used for estimating the first period totals. This day was treated separately and its data were added to those of the first period, only after all total estimates for the rest of the period had been completed.

No overlap computation was necessary for the period September 22 to October 31. The total boats counted on any one census day during this period were used in the same manner as the estimated total boat counts were used during the previous period. Thus, Steps 1 and 2 were eliminated. All other estimate computations were carried out as in Steps 3 through 11.

Estimates for the Georgetown Lake winter creel census data were computed similar to the method employed on the summer data, except for the following considerations:

1. The winter season consisted only of Saturdays, Sundays and legal holidays from December 14, 1958 until March 1, 1959, inclusive.

2. Except for the opening day of the winter season (December 14), car counts were used in lieu of boat counts. These car counts were made every three hours on census days, between the hours of 8:00 a.m. and 10:00 p.m. On December 14, fishermen counts were used in place of car counts.

3. There were no a.m. or p.m. census days and thus no overlap periods during the winter season. Thus, total estimates were computed the same as the September 22 to October 31 data, during the summer season.

As previously mentioned, creel census technicians were instructed to obtain as many weights of fish by species as possible, during each period of the summer census. This average weight by period method was employed, so that allowance could be made for weight increase of the fish during the summer growing season. However, with cutthroat trout being by far the most numerous species in the catch, it was not always possible to obtain enough weights of the other fish species during any one period to constitute what was considered a valid sample. Therefore, after consideration of the available summer weight data, the following procedure was adopted for determining estimated average weights per fish by species:

1. A minimum of 20 fish per species, per census period, was required for an average estimated weight of the fish species taken during the period.

2. If weight data for the minimum amount of 20 fish per species were not available for any one period, those weights available for the previous and following period were added to the weights of the period concerned. The average weight thus computed was considered the average weight for the period concerned. If there was no period preceeding the period concerned, weights of fish by species from the following period only were used to determine average weight of the individual fish by species.

3. Where less than 20 fish had been weighed for any one species during the entire summer season, the weights of all fish weighed for the species concerned were used to obtain the average weight of the particular species.

During the winter angling season, when more than one census technician was checking anglers, weight samples were much easier to obtain. Also, during the winter season, fish growth as determined by previous age and growth analysis, is all but curtailed. Thus, average weights by species for the winter season were derived by species from all fish weighed during the entire season.

A 20 pound capacity scale, weighing in units of ounces and pounds, was used for taking fish weights. For purposes of average weight computations of the catch by species, ounces were converted to tenths of pounds.

The average weights of all fish by species thus obtained were multiplied by the estimated number of fish by species taken during the period concerned. By so doing, the total estimated weight of all fish species for both the summer and winter season was obtained.

Shore anglers were counted and contacted by the same method described for boats and boat anglers. However, end of trip contacts with shore fishing parties were far more difficult to make than with boat parties. Because of this, the percent contact of shore fishermen was so low (1.4) for the entire season that catch and pressure estimates made from this data would be very unreliable. Estimates of numbers of shore fishermen were made by the methods described for estimated total boat trips (except that their amount of trips was computed by period rather than by individual days) merely to give some indication of the amount of fishing pressure that was "missed" by the census. No attempt was made to estimate the shore fishermen catch. Shore fishermen numbers are not included with total season estimates under "Findings". They are described and discussed separately under both "Findings" and "Recommendations".

Findings:

An analysis of the summer and winter creel census data from Georgetown Lake shows that the catch consists of the following seven game fish species:

Rainbow trout	*Salmo gairdneri*
Cutthroat trout	*Salmo clarki*
Eastern brook trout	*Salvelinus fontinalis*
Dolly Varden trout	*Salvelinus alpinus malma*
Grayling	*Thymallus signifer*
Silver salmon	*Oncorhynchus kisutch*
Kokanee salmon	*Oncorhynchus nerka kennerlyi*

Only one Dolly Varden trout was checked during both seasons. This one fish was not listed in the catch estimate. Anglers have reported catching an occasional brown trout (*Salmo trutta*), in the lake, but none were checked during the creel census study.

Past planting records are ambiguous as to the sub-specific types of fish planted in the lake. This is particularly so in the case of cutthroat trout. According to Weisel (1957) there are two distinct cutthroat trout sub-species recognized in Montana. The coastal cutthroat, *Salmo clarki clarki*, native to the west side of the Continental Divide, and the Yellowstone cutthroat, *Salmo clarki lewisi*, indigenous to headwaters of both sides of the Continental Divide.

It appears from visual observations, and from oral, historical, planting information, that both of the above sub-specific, cutthroat-trout forms have been planted in Georgetown Lake at one time or another. Also, written, historical records state that in 1929 cutthroat trout from Lake Tahoe, Nevada were planted in Georgetown Lake.

The present cutthroat trout in Georgetown Lake is known to both fish culturists and fishermen alike as the "Georgetown cutthroat", or the "Georgetown native". The writers make no attempt to taxonomically classify this fish.

During the summer fishing season (June 29-October 31, 1958), an estimated 24,654 fishermen fished for an estimated 94,824 hours, and caught an estimated 47,401 game fish. Total estimated weight of these fish was 40,249 pounds or 20.1 tons. A total of 1,169 boats were contacted by census technicians during the summer season.

Table 3 lists the estimated pressure, catch by species, and pounds by species by periods for the summer angling season.

An analysis of the estimated summer catch data shows that 88 percent of the catch was cutthroat trout, 5.7 percent eastern brook trout, and 3.4 percent grayling. The remaining 2.9 percent consisted of rainbow trout, silver salmon, and kokanee salmon.

A comparison of numbers of fish to pounds of fish for the summer season is presented in Figure 2. These data show that the only noticeable weight per catch increase took place between the third and fourth periods of the summer season.

The estimate data also show that numbers of fishermen declined throughout the summer season. By comparison, the catch per day dropped abruptly between the first and second periods, rose between the second and third periods, and dropped again between the third and fourth periods. The above data is graphically illustrated in Figure 3.

A comparison between the catch on opening day (June 29) and the catch during the remainder of the summer season shows the following: (1) On opening day, 8.5 percent of the total number of anglers, who fished on the lake during the entire summer season, applied 13.3 percent of the total season's pressure, and harvested 20.0 percent of the total season's catch; and (2) compared to the mythical "average day" of the summer season, on opening day, 10.7 times as many anglers applied 16.6 times as much angling pressure and harvested 23.8 times as many fish.

Throughout the winter season (Saturdays, Sundays, and legal holidays from December 14, 1958 through March 1, 1959), an estimated 17,974 fishermen fished for an estimated 83,369 fisherman hours, and harvested an estimated 70,252 game fish. Total estimated weight for these game fish was 42,125 pounds, or 21.1 tons. A total of 1,142 cars were contacted throughout the winter season.

Table 4 lists the total estimated pressure, catch by species, and pounds by species by periods for the winter season.

During the summer of 1958, the following numbers and species of fish were planted in Georgetown Lake: grayling 20,000; rainbow trout 150,898; and cutthroat trout 133,121. The above rainbow and cutthroat were three inches in length or longer, when planted.

One-third each of the above rainbow and cutthroat trout plants were marked by removal of the right premaxillary bone. The marked hatchery fish, while entirely absent from the summer catch, appeared in the winter catch on opening day and were present in this catch throughout the entire season. As shown on Table 4, an estimated 631 marked rainbow, and 1,773 marked cutthroat trout were harvested during the winter season. If it is assumed that unmarked fish from the 1958 plant were harvested in proportion to the marked fish of this plant, then an estimated total of 1,893 rainbow and 5,319 cutthroat trout of the 1958 plant were harvested during the winter season of 1958-1959. This, then, would indicate that 10.3 percent of the total fish harvested during the winter season consisted of rainbow and cutthroat trout planted during the summer of 1958. The figures also indicate a return to the creel of 1.3 percent for rainbow and 4.0 percent for cutthroat, during the first season they appeared in the catch.

An analysis of the estimated winter catch data shows that 89.6 percent of the catch was cutthroat trout (both marked and unmarked) and 5.4 percent eastern brook trout. The remaining 5 percent consisted of rainbow trout (both marked and unmarked), grayling, silver salmon and kokanee salmon.

The winter kokanee salmon catch dropped from an estimated 850 fish to 32 fish between the first and second periods of the winter census. No kokanee salmon were checked during the third period of the winter season. This abrupt drop in the kokanee salmon catch is attributed to the completion of the life cycle of this particular age class of kokanee salmon that had entered the fishery during the fall of 1958. It is interesting to note that kokanee salmon have never appeared on the planting record for Georgetown Lake.

A more direct proportion between average catch and average fishermen per day, per period was evident during the winter season than during the summer season.

An estimated 22,851 more fish were harvested during the winter season than during the summer season. Of these 22,851 fish, 21,303 were cutthroat trout. A comparison between estimated total summer and winter catch by species is presented in Figure 5.

Weight average for all fish was 0.8 pounds per fish, during the summer season and 0.6 pounds per fish for the winter season. This decrease in average weight per fish during the winter season was probably due to the presence of rainbow and cutthroat trout from the 1958 plant appearing in the catch. A comparison of total weights of fish by species between the summer and winter seasons is presented in Figure 6.

The average catch per hour was 0.5 fish for the summer season and 0.8 fish for the winter. Also, a greater fluctuation in catch per hour, between periods, was evident during the summer than during the winter. Catch per hour data by periods for both summer and winter seasons are presented in Figures 8 and 9 respectively.

During the summer season, the catch per fisherman averaged 1.9 fish or 1.6 pounds, and during the winter the average catch was 3.9 fish or 2.3 pounds per fisherman.

Combined total estimates for both summer and winter seasons show that 42,628 fishermen fished for 178,193 fisherman hours and caught 117,653 game fish. Estimated total weights for both summer and winter seasons was 82,374 pounds or 41.2 tons. This weight estimate represents a yield of 29.4 pounds of fish per surface acre of the lake.

A total of 2,311 parties, or 4,801 individual anglers were contacted by creel census technicians during the summer and winter seasons.

Total estimated shore fishermen, shore fishermen contacted and percent of contact are shown by periods for the summer season on Table 5. These data are not included in the above listed totals for the lake. Estimates of effort and catch were not made for shore fishermen. The percent contact was too low to permit worthwhile total estimates to be made. The estimate of these numbers was made and included merely to illustrate that all other estimates in this report most likely are lower than the true figures.

An effort was made to collect scale samples from as many fish as possible during the summer season. However, because cutthroat trout made up such a large portion of the catch, it was not possible to obtain enough scale samples from all the other species. Three species, from which enough scale samples were obtained to be considered worthy of inclusion, were cutthroat trout, rainbow trout and grayling. Age and growth summaries for these three species are presented in Table 6. Rainbow trout had the fastest growth rate of these three species in Georgetown Lake.

Recommendations:

1. Confidence limits of boat angler estimates were not computed for this season's data because the writers felt such limits would be of little value in describing the precision of total estimates which ignored shore fishermen. However, to better evaluate the methods used, it is recommended that confidence limits be computed for the boat angler pressure and harvest estimates before this census is operated again.

2. The census study should be continued according to the following recommendations for at least a five-year period, in order to provide a suitably sound basis for the management of this lake.

   a. The same a.m., p.m., weekday, weekend day divisions of census days and criteria for setting up the census schedule as were used last year should be used again.

   b. Boat and shore angler counts should be at three-hour intervals, and arranged similarly to the counts used in periods 2 and 3.

   c. In the third period, shore angler counts (but not boat counts) should be continued until 2000.

   d. A postcard, name record, method should be employed for obtaining a sufficient number of completed-trip, catch-and-effort, contacts from shore anglers.

   e. Confidence limits should be computed for estimates based on data collected in future years.

   f. A larger and safer boat should be provided for the technicians operating the summer census.

   g. One-third of each species in each year's plant should be marked for the duration of the census.

   h. Other portions of the district work load should be adjusted so that the census technicians could receive closer supervision from permanent project personnel. This may well require that the Georgetown census be operated only in alternate years. Although this would result in the loss of data of immediate value to the management of the lake, it would extend the census in time and would likely provide as valuable data for the lake's long-term management as would a census run every year for a shorter length of time. Population sampling should be repeated yearly.

3. Management recommendations for the lake, based on previous planting records, past experience, and last year's census and survey data (see completion report for Job No. I for the survey data) are as follows:

   a. Present seasons should be continued, at least until the census has been operated another year.

b. The yearly plant should be at least 100 trout per acre (280,000 total) and these fish should be three inches or longer, when planted. From the standpoint of both biology and public relations, rainbow trout are recommended. Their growth rate is fastest (Table 6) and their ability and/or inclination to put up a more spectacular battle than the cutthroat when hooked, makes them more desirable to most anglers.

However, since Georgetown Lake is one of the sources of the Montana hatchery system's trout egg supply, its planting must be dictated by the statewide needs of that system. Therefore, the lake's planting recommendations cannot be based on what is most desirable for it alone.

The hatchery system currently needs cutthroat trout from the Georgetown Lake spawn taking stations. So, from a strictly hatchery standpoint, cutthroat trout only should be planted.

Both of the above needs could be satisfied by a plant of half of each of these species, however, again from a biological standpoint, in order to prevent hybridization, rainbow and cutthroat trout should not be planted together. Thus, a sound biological recommendation for this lake must be to plant either rainbow or cutthroat trout, but not to plant both at the same time.

Since the Georgetown cutthroat is a hybrid of various cutthroat and rainbow strains, it is recommended that its use be curtailed as fast as stocks of pure strain Yellowstone and west slope cutthroat can be built up. When such a time arrives, it is recommended the plant be changed to rainbow trout only, and the spawn taking stations operated as sources of rainbow eggs. Because of a limited spawning area which is filled with resident brook trout, and a large red-sided shiner population in the lake itself, it is expected that Georgetown Lake will continue to require annual stocking with three-inch and longer trout, in order to maintain a suitable sport fishery.

Literature or references cited:

Moyle, John B. and Donald R. Franklin, 1955. Quantitative Creel Census on Twelve Minnesota Lakes. Trans. Am. Fish. Soc., Vol. 2:85, pp. 28-38.

Weisel, George F., 1957. Fish Guide for Intermountain Montana. Mont. State Univ. Press, 88 pp.

Prepared by Robert C. Averett and Arthur N. Whitney

Approved by ____________

Date 7 July 1959

Table 1. Georgetown Lake summer creel census schedule.

Month	Period	Sa	Su	M	Tu	W	Th	F
June			29A	30A	1A	2	3P	4P
July		5A	6P	7	8	9	10A	11P
	1	12P	13A	14P	15A	16	17A	18
		19	20P	21	22	23P	24	25
		26P	27A	28A	29	30	31	
								1P
		2A	3P	4	5	6	7A	8P
August		9P	10A	11A	12P	13	14	15
	2	16A	17P	18P	19	20	21P	22
		23P	24A	25A	26	27P	28	29
		30A	31P					
				1A	2	3	4	5P
		6P	7A	8A	9P	10	11	12A
September		13A	14P	15	16P	17A	18P	19A
	3	20P	21A	22*	23	24*	25	26
		27	28*	29	30*			
						1	2	3
		4*	5	6*	7	8	9*	10
October		11	12*	13	14*	15	16	17*
	4	18*	19	20	21	22*	23*	24
		25	26	27*	28	29	30*	31

Legend: A.M. Days - A
P.M. Days - P
All Day Checks*

Period 1 - A.M. 6:00 a.m. - 4:00 p.m.
P.M. 12:00 noon -10:00 p.m.
Period 2 & 3 - A.M. 8:00 a.m. - 5:00 p.m.
P.M. 11:00 a.m. -10:00 p.m.
Period 4 - Boat counts - 8:00 a.m.-5:00 p.m.
Angler checks - 12:00 noon-dark

Table 2. Georgetown Lake winter creel census schedule.

Period	Month	Saturday	Sunday	Holiday
1	December		14*	
		20*	21	25
		27	28*	
2	January			1
		3*	4	
		10	11*	
		17*	18	
		24	25*	
		31*		
3	February-March		1	
		7	8*	12*
		14*	15*	
		21*	22*	23*
		28*		
			1*	

* Denotes days censused.

Table 3.* Estimated boats, fishermen, pressure and catch for Georgetown Lake summer creel census, 1958.

Period	Boats	Fishermen	Fishermen Hours	Rainbow No.	Rainbow Wt.	Cutthroat No.	Cutthroat Wt.
29 June 26 July	5,456	12,919	50,579	586	1,289	27,156	21,725
27 July 23 August	2,678	5,722	22,590	126	227	4,764	3,811
24 August 30 September	2,707	5,338	18,752	232	511	9,115	7,292
1 October 31 October	314	675	2,903	37	66	639	575
Totals	11,155	24,654	94,824	981	2,143	41,674	33,403

* Continued on following page.

Table 3 (cont'd). Estimated boats, fishermen, pressure and catch for Georgetown Lake summer creel census, 1958.

Eastern brook		Grayling		Silver salmon		Kokanee salmon		Total	
No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
768	922	334	234	227	386	66	46	29,137	24,602
582	640	844	591	83	142	0	0	6,399	5,461
1,037	1,037	441	309	51	87	0	0	10,876	9,222
299	299	0	0	14	24	0	0	989	964
2,686	2,898	1,619	1,134	375	639	66	46	47,401	40,249

Table 4.* Estimated cars, fishermen, fisherman hours, catch and weight by species, by periods, for Georgetown Lake winter creel census.

Period	Cars Contacted	Fishermen	Fisherman hours	Rainbow (marked)		Cutthroat (marked)		Rainbow	
				No.	Wt.	No.	Wt.	No.	Wt.
14 Dec. 31 Dec.	4,824	6,616	31,708	274	110	332	100	714	643
1 Jan. 31 Jan.	4,026	8,536	39,338	296	118	1,024	307	570	513
1 Feb. 1 March	1,381	2,822	12,323	61	24	417	125	238	214
Totals	10,231	17,974	83,369	631	252	1,773	532	1,522	1,370

Table 4 (cont'd). Estimated cars, fishermen, fisherman hours, catch and weight by species, by periods, for Georgetown Lake winter creel census.

Cutthroat		Eastern brook		Grayling		Silver salmon		Kokanee salmon		Total	
No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
24,612	14,767	1,928	1,157	164	98	24	14	850	680	28,898	17,569
27,590	16,554	1,610	966	132	79	64	38	32	26	31,318	18,601
9,002	5,401	288	173	17	10	13	8	0	0	10,036	5,955
61,204	36,722	3,826	2,296	313	187	101	60	882	706	70,252	42,125

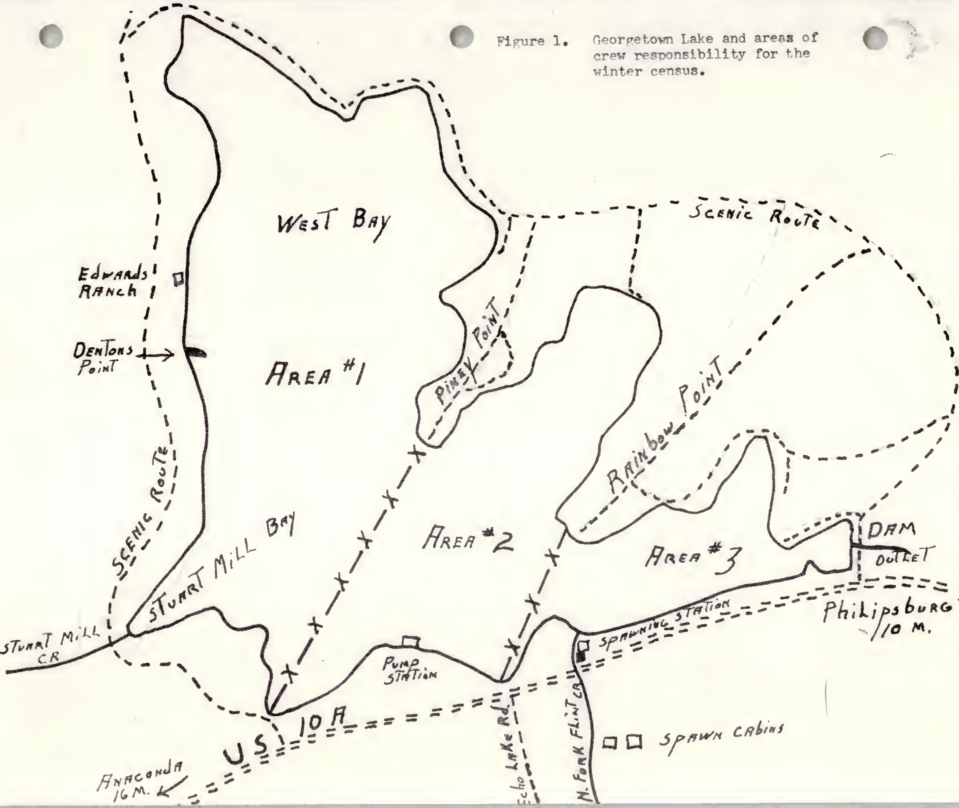
Table 5. Total estimated shore anglers, shore angler contacts and percent contact, by periods, summer season.

Period No.	1	2	3	4	Total for season
Week days	1,032	1,135	1,678	1,245	5,090
Weekend days	2,009	976	927	416	4,328
Total	3,041	2,111	2,605	1,661	9,418
Contacts	72	4	13	44	133
Percent contact	2.3	0.2	0.5	2.6	1.4

Table 6. Length, in inches, at annulus formation of cutthroat and rainbow trout and grayling. From 1958 scale samples, Georgetown Lake summer census. Numbers in parentheses indicate sample size.

SPECIES	ANNULUS NUMBER I	II	III	IV	V
Cutthroat trout	3.9 (124)	9.4 (119)	13.6 (47)	16.7 (15)	23.1 (1)
Rainbow trout	6.1 (24)	13.5 (23)	15.9 (1)		
Grayling	3.4 (32)	9.4 (27)	13.0 (16)		

Figure 1. Georgetown Lake and areas of crew responsibility for the winter census.



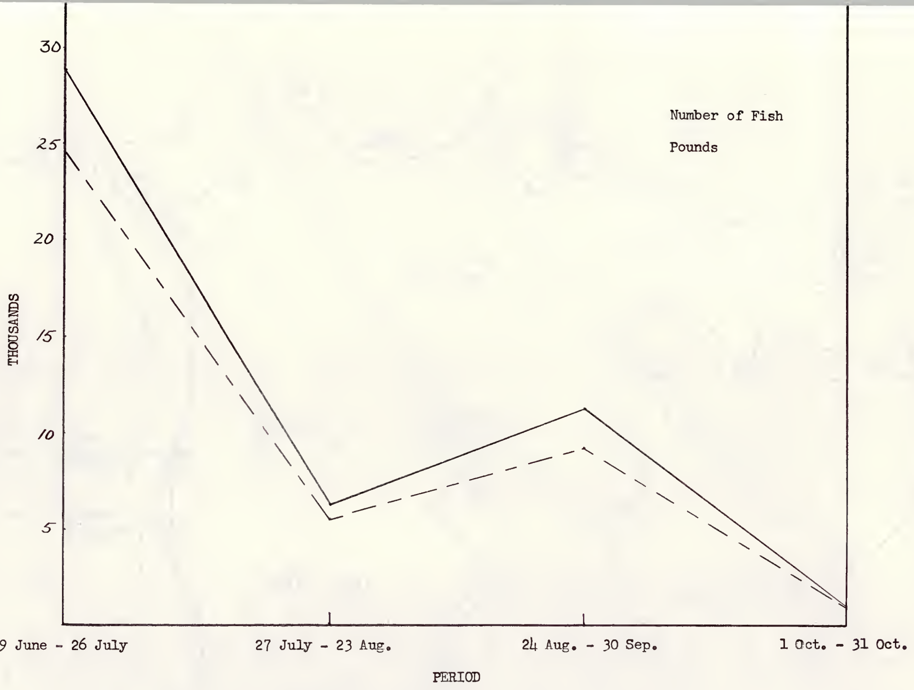


Figure 2. Comparison of numbers to weights of fish per period. Summer Census.

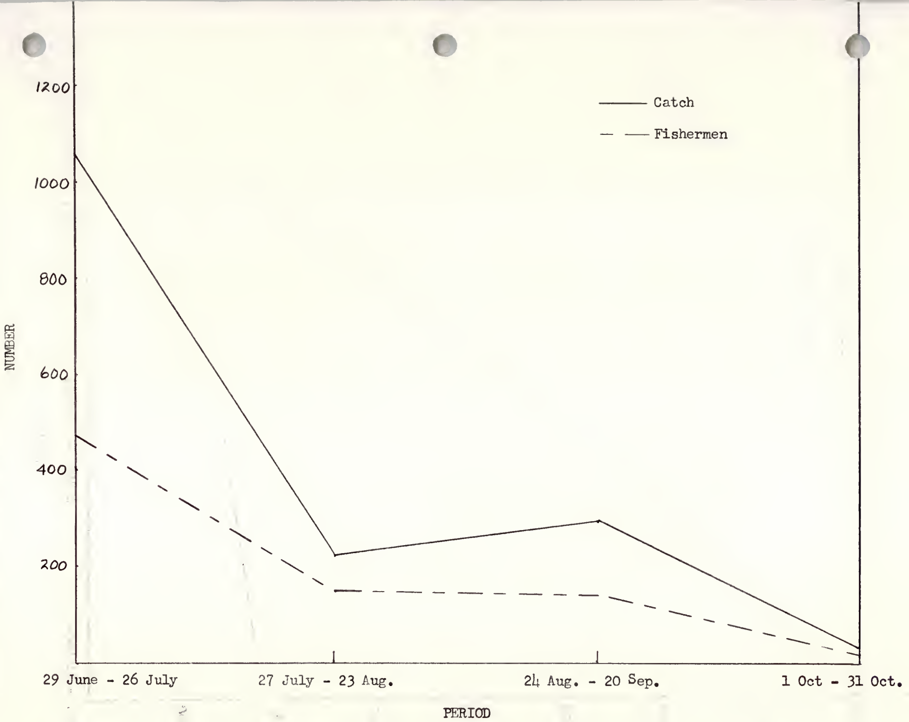


Figure 3. Average catch and Fishermen per day per period. Summer Census.

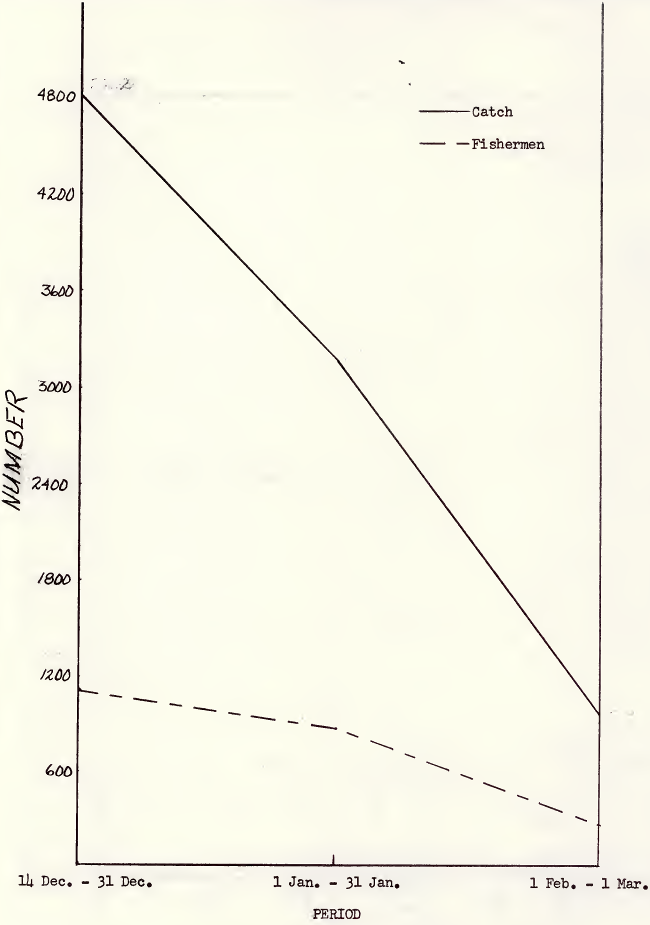


Figure 4. Average catch and fishermen per day per period. Winter Census.

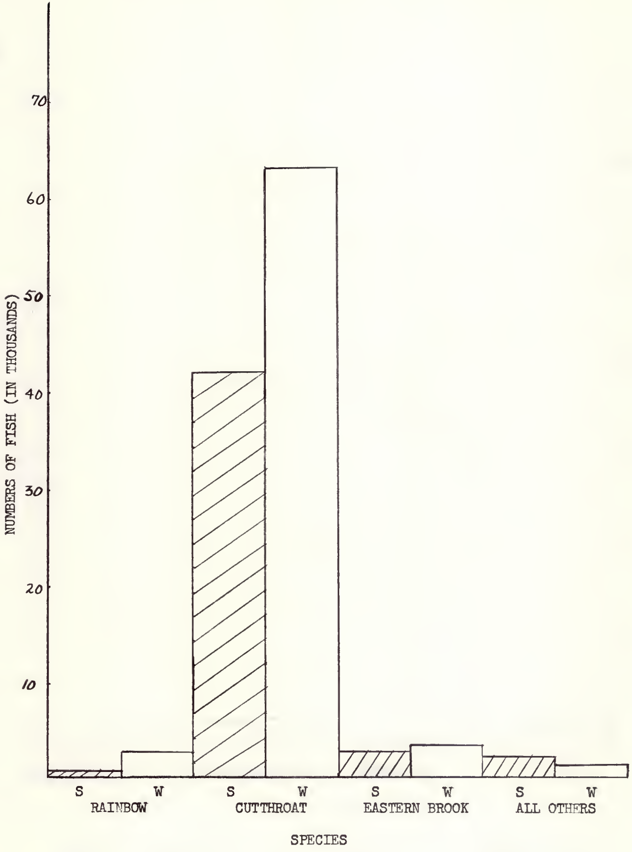


Figure 5. Comparison of numbers of fish in summer (S) and winter (W) catches, by species, from Georgetown Lake.

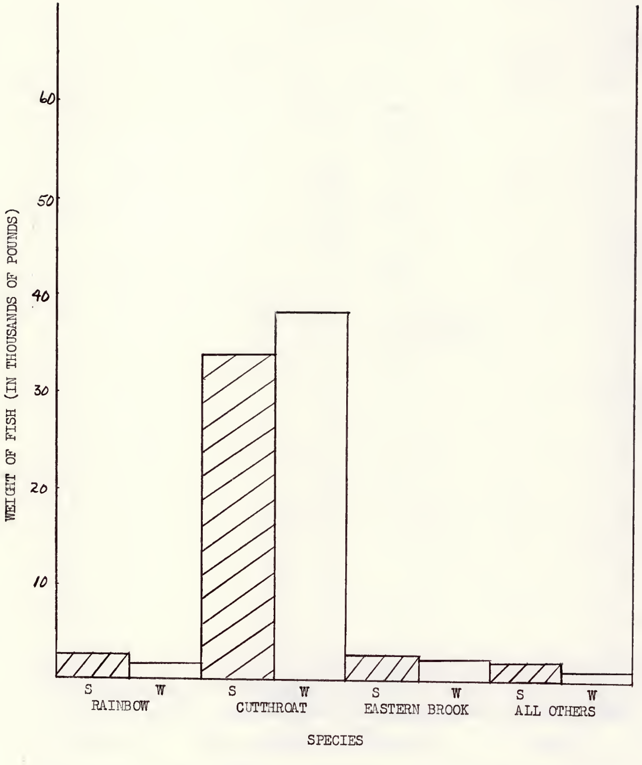


Figure 6. Comparison of weights of fish in summer (S) and winter (W) catches, by species, from Georgetown Lake.

Figure 7 Georgetown Lake census form.

GEORGETOWN LAKE CREEL CENSUS

WEATHER:

TOTALS

Date ____________________

Sheet ________ of ________

Censused by ____________________

Boat	
Shore	
No.F'men	
Time Start	
Time End	
Total Time	
Man Hours	
*RB	No.
	Wt.
*CT	No.
	Wt.
RB	No.
	Wt.
CT	No.
	Wt.
EB	No.
	Wt.
GR	No.
	Wt.
SS	No.
	Wt.
	No.
	Wt.
	No.
	Wt.
Hardware	
Bait	
Flies	

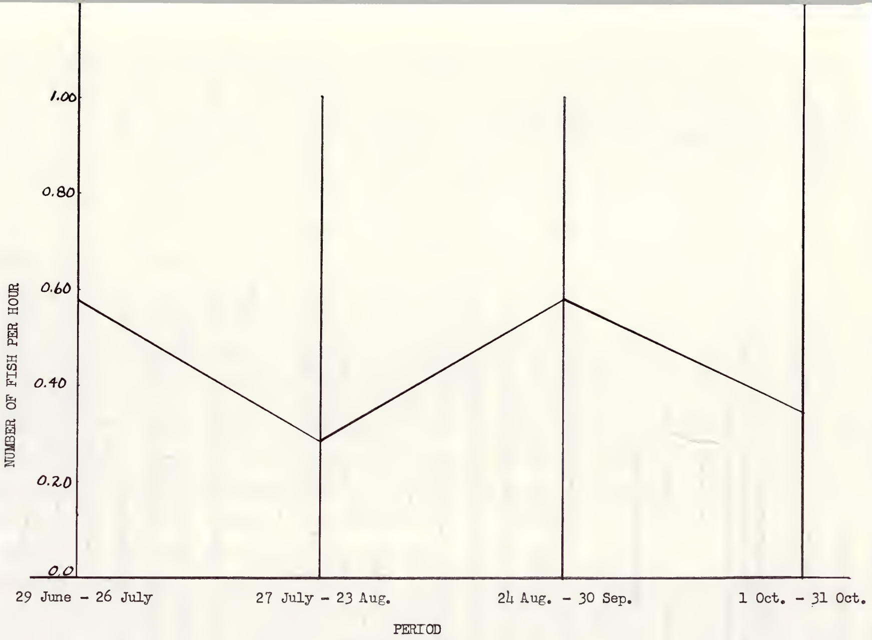


Figure 8. Average catch per hour, by periods. Summer census.

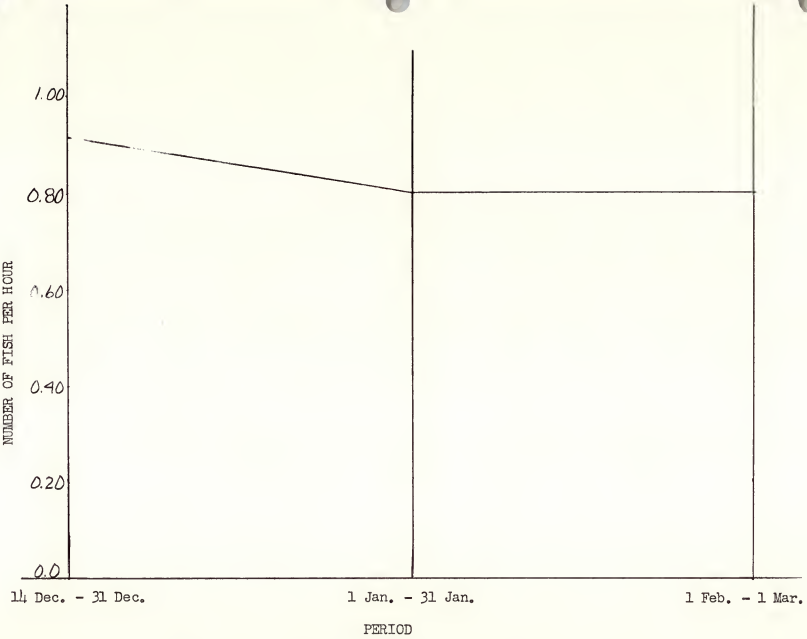


Figure 9. Average catch per hour, by periods. Winter census.

S
639.31
F-12-R-5
III

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MONTANA DEPARTMENT OF FISH AND GAME
FEDERAL AID IN FISH RESTORATION SECTION
HELENA, MONTANA

JOB COMPLETION REPORT
INVESTIGATIONS PROJECTS

State of Montana

Project No. F-12-R-5

Job No. III

Period Covered May 1, 1958 - April 30, 1959

Name Western Montana Fishery Study

Title Georgetown Lake Study

Abstract:

A creel census was conducted on Georgetown Lake during the summer angling season of 1958 and the winter angling season of 1958-59. The primary objective of this census was to obtain catch and effort information for better management of this popular fishing lake.

Total estimated pressure and catch for the summer and winter seasons and the methods used in computing those estimates are presented.

Recommendations are made to continue the census with some changes in techniques, to obtain closer supervision of the census technicians, and to mark portions of future trout plants in the lake.

Objectives:

Georgetown Lake is one of the most popular and perhaps the most productive mountain lake in western Montana. Its area is 2,800 acres and the lake is located about mid-way between the towns of Anaconda and Philipsburg, Montana.

Past management practices used on Georgetown Lake have consisted of: (1) planting various species and sizes of game fish; (2) opening the summer season one month later and closing it one month earlier than the general trout season; and (3) opening a winter season from mid-December until March 1, on Saturdays, Sundays and legal holidays. At various times since 1912, Georgetown Lake has been managed for rainbow trout, cutthroat trout, grayling, and a cutthroat-grayling combination. Eastern brook trout and silver salmon have also been stocked. Since 1955, the lake has been managed primarily for cutthroat trout. The above management practices have been based upon information taken from spawn trap records, statewide warden creel census and angler reports and also upon the needs of the statewide spawn taking operations.

Information from these sources indicates that: (1) there is a decrease in the individual size of the cutthroat trout in the spawning run during the past five years; (2) angler success has decreased during the same period; (3) angler success is higher during the winter season than during the summer season; and (4) anglers are generally dissatisfied with the present cutthroat management of the lake.

PLEASE RETURN

In that no tally of numbers of fish in each spawning run has been kept, and the statewide creel census has given very light coverage to this lake, the cause of these apparent decreases in fish size and fishing success cannot be determined. It was, therefore, apparent that much more detailed information than is now available would be necessary to manage this popular fishing lake successfully in the future.

Prior to the opening of the summer trout season on Georgetown Lake (June 29, 1958) an intensive creel census was designed. The objectives of this census were to collect the following information during both the summer and winter angling seasons.

1. Annual estimated total catch of fish from the lake, by species, in both numbers and pounds.
2. Total annual fishing pressure on the lake.
3. Comparative data between the summer and winter angling seasons in regard to catch, species composition, and fishing pressure.

Techniques Used:

The Georgetown Lake summer creel census began on June 29, 1958 and ended on October 31, 1958. Throughout this 125-day period a creel census technician counted boats and checked angler catches 30 weekend and holiday days, and 38 week days. Table 1 shows the days censused during each period of the summer season.

Census days were divided into a.m. and p.m. days. From June 29 until July 26, the a.m. check hours were from 6:00 a.m. until 4:00 p.m.; and the p.m. check hours were from 12:00 noon until 10:00 p.m. Boat counts were made every two hours, during this period, commencing at the starting hour for both a.m. and p.m. census days.

From July 27 until September 21, the a.m. check hours were from 8:00 a.m. until 5:00 p.m., and the p.m. check hours were from 11:00 a.m. until 10:00 p.m. During this period, boat counts were made every three hours, commencing at the starting hour for both a.m. and p.m. check days.

Due to fewer daylight hours, the a.m. and p.m. division of census days was discontinued from September 22 to October 31. An all day check, from 8:00 a.m. until 5:00 p.m., was in effect during this period. Boat counts were made every three hours and angler contacts were made from 12:00 noon until dark.

The census technician used a 12 foot boat, powered by a 15 h.p. outboard motor, to make the periodic boat counts. The number of boats counted, along with the count hour, was recorded on a boat count form.

Between boat count periods, the census technician would endeavor to contact as many boat parties as possible who had completed their fishing trip. Upon contacting a party, the following information was recorded:

1. Number of anglers in boat party.
2. Length of time party had been fishing.
3. Number of man-hours party had fished (ascertained from number of fishermen in party times hours party had fished).
4. Number of fish by species which the party had caught.

When time permitted, the census technician would obtain total weight by species of all fish in the catch. All the above information was recorded on a creel census form, a sample of which is shown on Figure 7.

From December 14, 1958 through March 1, 1959 the winter angling season was open on Georgetown Lake during Saturdays, Sundays and legal holidays. Table 2 lists the days the lake was checked during the winter season.

On the opening day of the winter angling season (December 14), an attempt was made to count all fishermen and "ice" houses on the lake, every three hours. Fishermen contacted were recorded as "house" or "open ice" anglers and from this record an average number of anglers per house was obtained. This method was feasable only on opening day, when all houses were occupied. On all following days, a periodic car count every three hours was used for estimating total pressure by the same method used with boat counts in the summer census.

In order to insure better coverage during the peak of the winter season, the lake was divided into three areas of responsibility. These are shown on Figure 1.

One census technician was assigned to each of these areas and instructed to make car counts every three hours, and to contact as many angler parties as possible, who had completed their angling trips.

Information recorded was the same as that taken during the summer season.

The winter season was divided into three periods. These were: December 14 to December 31, 1958; January 1 to January 31, 1959; and February 1 to March 1, 1959.

In addition to car counts, and angler contacts, one census technician was assigned the job of taking total weights by species of as many fish as possible. This job was assigned to a different area of responsibility each census day, so as to insure catch weight data from all areas of the lake.

During the summer of 1958, 133,121 cutthroat trout and 150,898 rainbow trout (three inches in length or longer) were planted in Georgetown Lake. One-third of the fish of each species were marked by removing the right premaxillary bone. Census technicians were informed of these marked fish and were instructed to record them separately on the creel census form. Total pressure and catch estimates were computed similar to the method described by Moyle and Franklin (1955).

Census data taken on Saturdays, Sundays and legal holidays were computed separately from weekend check data because of the increased angling pressure on the former.

During the first, second, and most of the third period of the summer census, an overlap period from 11:00 a.m. until 5:00 p.m. was present each day censused. Boats counted during this overlap period were used to estimate boats present during the p.m. period of the a.m. census days and the a.m. period of the p.m. census days.

An example of how this computation was carried out is as follows: From July 27 until August 23, there were four a.m. weekend days censused, and four p.m. weekend days censused. Boats counted during the a.m. sections of this period were listed under three columns as (1) boats counted in overlap period; (2) boats counted in non-overlap period; and (3) total boats counted for the entire period (the sum of 1 and 2). Boats counted during the p.m. days of this period were arranged in the same order.

After arranging the boat counts in this order for both a.m. and p.m. census days, the following step by step method of computation was used. Week days and weekend days were treated separately.

1. Both a.m. and p.m. columns of boats counted in overlap and total boats contacted were totaled. The sum of the total boats counted column was divided by the sum of the total boats in the overlap column for both a.m. and p.m. check days. The quotient thus determined from the p.m. days was used to estimate the total boat count for the a.m. days. The quotient for the a.m. days was used to estimate the total boat count for the p.m. days.

2. The above quotient was used as a constant in determining estimated boats for each individual a.m. and p.m. day. This constant was multiplied by the boats counted in the overlap period for the individual day under consideration. Then this product was added to the number of boats in the non-overlap period for the day. The sum of these two numbers gave the estimated total boat count for the day.

3. Next, the total boat hours were tallied from the census sheet. These boat hours were obtained from actual contacts made by the census technician, and consisted only of completed boat trips.

4. After the total boat hours were obtained, the average length of trip was determined. This was the quotient obtained by dividing the total boat hours by the total boats contacted during the particular day under consideration.

5. After determining the average length of trip, the boat "turnover" quotient was computed. That is, the theoretical number of times during the census day that one group of boats leaves the lake, and another group of boats takes their place. This quotient was determined by dividing the number of angling hours per day (17 hours in Montana) by the average length of trip.

6. Next, the average number of boats per count was computed. This was obtained by dividing the estimated total boat count (from Step 2) by the total number of boat counts that would have been made on a complete census day.

7. The average number of boats per count quotient was then multiplied by the boat "turnover" quotient. This product was the total estimated number of boat trips for the census day.

Following is an algebraic description of the methods used for the expansion of a.m. and p.m. boat count and contact data to full day boat trip estimates, for each individual census days of one period:

Where:

A = Individual a.m. day boat count.
B = Number of boats in A counted during overlap period.
C = A - B.
P = Individual p.m. day boat count.
Q = Number of boats in P counted during overlap period.
R = P - Q.

Then:

$$\frac{\Sigma A}{\Sigma B} \cdot Q + R = \text{Estimated total boat count for individual p.m. day } (E_{BC})$$

and

$$\frac{\Sigma P}{\Sigma Q} \cdot B + C = \text{Estimated total boat count for individual a.m. day } (E_{BC})$$

And where:

H = Number of hours in fishing day.
N = Number of boat counts which would have been made in a full day (not a.m. or p.m.).
L = Average length of trip (from contact data).

Then:

$$\frac{E_{BC}}{N} \cdot \frac{H}{L} = \text{Estimated total boat trips for one individual day } (E_{BT})$$

8. After determining the estimated total boat trips for the day, it was necessary to have a constant to proportionately increase the catch by species, fishermen, and fishermen hours. This constant was obtained by dividing the total estimated boats for the census day by the total boats contacted during the census day. This constant was then multiplied by the total fish checked (by species), fishermen contacted, and fishermen hours for the census day.

9. After the above estimate was made, the number of fishermen contacted was divided by the number of estimated fishermen. This quotient, multiplied by 100, gave the percent contact for the census day.

10. After estimates for each a.m. and p.m. day checked during the period were computed, it was then necessary to estimate the total boats, catch by species, fishermen and fishermen hours for the period concerned. This was accomplished by totaling the individual estimates for all days censused during the period, both a.m. and p.m. Next, the number of days in the period was divided by the number of days (both a.m. and p.m.) that were censused during the period. This quotient was then multiplied by the total number of estimated boats, catch by species, fishermen, and fishermen hours for the days censused. The products thus obtained were considered the total estimated boats, catch, fishermen and fishermen hours for the period concerned. The percent contact for the period was obtained by dividing the total boats contacted by the estimated total boats, and multiplying this quotient by 100.

On opening day (June 29), with from 3 to 9 census takers contacting anglers, contacts exceeded 40 percent of the total estimated fishermen. On the following days, with one census technician working, contacts ranged from 5 to 15 percent. The opening day's contact data, because this day's fishing pressure was markedly higher than any other censused day of the season, was not used for estimating the first period totals. This day was treated separately and its data were added to those of the first period, only after all total estimates for the rest of the period had been completed.

No overlap computation was necessary for the period September 22 to October 31. The total boats counted on any one census day during this period were used in the same manner as the estimated total boat counts were used during the previous period. Thus, Steps 1 and 2 were eliminated. All other estimate computations were carried out as in Steps 3 through 11.

Estimates for the Georgetown Lake winter creel census data were computed similar to the method employed on the summer data, except for the following considerations:

1. The winter season consisted only of Saturdays, Sundays and legal holidays from December 14, 1958 until March 1, 1959, inclusive.

2. Except for the opening day of the winter season (December 14), car counts were used in lieu of boat counts. These car counts were made every three hours on census days, between the hours of 8:00 a.m. and 10:00 p.m. On December 14, fishermen counts were used in place of car counts.

3. There were no a.m. or p.m. census days and thus no overlap periods during the winter season. Thus, total estimates were computed the same as the September 22 to October 31 data, during the summer season.

As previously mentioned, creel census technicians were instructed to obtain as many weights of fish by species as possible, during each period of the summer census. This average weight by period method was employed, so that allowance could be made for weight increase of the fish during the summer growing season. However, with cutthroat trout being by far the most numerous species in the catch, it was not always possible to obtain enough weights of the other fish species during any one period to constitute what was considered a valid sample. Therefore, after consideration of the available summer weight data, the following procedure was adopted for determining estimated average weights per fish by species:

1. A minimum of 20 fish per species, per census period, was required for an average estimated weight of the fish species taken during the period.

2. If weight data for the minimum amount of 20 fish per species were not available for any one period, those weights available for the previous and following period were added to the weights of the period concerned. The average weight thus computed was considered the average weight for the period concerned. If there was no period preceeding the period concerned, weights of fish by species from the following period only were used to determine average weight of the individual fish by species.

3. Where less than 20 fish had been weighed for any one species during the entire summer season, the weights of all fish weighed for the species concerned were used to obtain the average weight of the particular species.

During the winter angling season, when more than one census technician was checking anglers, weight samples were much easier to obtain. Also, during the winter season, fish growth as determined by previous age and growth analysis, is all but curtailed. Thus, average weights by species for the winter season were derived by species from all fish weighed during the entire season.

A 20 pound capacity scale, weighing in units of ounces and pounds, was used for taking fish weights. For purposes of average weight computations of the catch by species, ounces were converted to tenths of pounds.

The average weights of all fish by species thus obtained were multiplied by the estimated number of fish by species taken during the period concerned. By so doing, the total estimated weight of all fish species for both the summer and winter season was obtained.

Shore anglers were counted and contacted by the same method described for boats and boat anglers. However, end of trip contacts with shore fishing parties were far more difficult to make than with boat parties. Because of this, the percent contact of shore fishermen was so low (1.4) for the entire season that catch and pressure estimates made from this data would be very unreliable. Estimates of numbers of shore fishermen were made by the methods described for estimated total boat trips (except that their amount of trips was computed by period rather than by individual days) merely to give some indication of the amount of fishing pressure that was "missed" by the census. No attempt was made to estimate the shore fishermen catch. Shore fishermen numbers are not included with total season estimates under "Findings". They are described and discussed separately under both "Findings" and "Recommendations".

Findings:

An analysis of the summer and winter creel census data from Georgetown Lake shows that the catch consists of the following seven game fish species:

Rainbow trout	*Salmo gairdneri*
Cutthroat trout	*Salmo clarki*
Eastern brook trout	*Salvelinus fontinalis*
Dolly Varden trout	*Salvelinus alpinus malma*
Grayling	*Thymallus signifer*
Silver salmon	*Oncorhynchus kisutch*
Kokanee salmon	*Oncorhynchus nerka kennerlyi*

Only one Dolly Varden trout was checked during both seasons. This one fish was not listed in the catch estimate. Anglers have reported catching an occasional brown trout (*Salmo trutta*), in the lake, but none were checked during the creel census study.

Past planting records are ambiguous as to the sub-specific types of fish planted in the lake. This is particularly so in the case of cutthroat trout. According to Weisel (1957) there are two distinct cutthroat trout sub-species recognized in Montana. The coastal cutthroat, *Salmo clarki clarki*, native to the west side of the Continental Divide, and the Yellowstone cutthroat, *Salmo clarki lewisi*, indigenous to headwaters of both sides of the Continental Divide.

It appears from visual observations, and from oral, historical, planting information, that both of the above sub-specific, cutthroat-trout forms have been planted in Georgetown Lake at one time or another. Also, written, historical records state that in 1929 cutthroat trout from Lake Tahoe, Nevada were planted in Georgetown Lake.

The present cutthroat trout in Georgetown Lake is known to both fish culturists and fishermen alike as the "Georgetown cutthroat", or the "Georgetown native". The writers make no attempt to taxonomically classify this fish.

During the summer fishing season (June 29-October 31, 1958), an estimated 24,654 fishermen fished for an estimated 94,824 hours, and caught an estimated 47,401 game fish. Total estimated weight of these fish was 40,249 pounds or 20.1 tons. A total of 1,169 boats were contacted by census technicians during the summer season.

Table 3 lists the estimated pressure, catch by species, and pounds by species by periods for the summer angling season.

An analysis of the estimated summer catch data shows that 88 percent of the catch was cutthroat trout, 5.7 percent eastern brook trout, and 3.4 percent grayling. The remaining 2.9 percent consisted of rainbow trout, silver salmon, and kokanee salmon.

A comparison of numbers of fish to pounds of fish for the summer season is presented in Figure 2. These data show that the only noticeable weight per catch increase took place between the third and fourth periods of the summer season.

The estimate data also show that numbers of fishermen declined throughout the summer season. By comparison, the catch per day dropped abruptly between the first and second periods, rose between the second and third periods, and dropped again between the third and fourth periods. The above data is graphically illustrated in Figure 3.

A comparison between the catch on opening day (June 29) and the catch during the remainder of the summer season shows the following: (1) On opening day, 8.5 percent of the total number of anglers, who fished on the lake during the entire summer season, applied 13.3 percent of the total season's pressure, and harvested 20.0 percent of the total season's catch; and (2) compared to the mythical "average day" of the summer season, on opening day, 10.7 times as many anglers applied 16.6 times as much angling pressure and harvested 23.8 times as many fish.

Throughout the winter season (Saturdays, Sundays, and legal holidays from December 14, 1958 through March 1, 1959), an estimated 17,974 fishermen fished for an estimated 83,369 fisherman hours, and harvested an estimated 70,252 game fish. Total estimated weight for these game fish was 42,125 pounds, or 21.1 tons. A total of 1,142 cars were contacted throughout the winter season.

Table 4 lists the total estimated pressure, catch by species, and pounds by species by periods for the winter season.

During the summer of 1958, the following numbers and species of fish were planted in Georgetown Lake: grayling 20,000; rainbow trout 150,898; and cutthroat trout 133,121. The above rainbow and cutthroat were three inches in length or longer, when planted.

One-third each of the above rainbow and cutthroat trout plants were marked by removal of the right premaxillary bone. The marked hatchery fish, while entirely absent from the summer catch, appeared in the winter catch on opening day and were present in this catch throughout the entire season. As shown on Table 4, an estimated 631 marked rainbow, and 1,773 marked cutthroat trout were harvested during the winter season. If it is assumed that unmarked fish from the 1958 plant were harvested in proportion to the marked fish of this plant, then an estimated total of 1,893 rainbow and 5,319 cutthroat trout of the 1958 plant were harvested during the winter season of 1958-1959. This, then, would indicate that 10.3 percent of the total fish harvested during the winter season consisted of rainbow and cutthroat trout planted during the summer of 1958. The figures also indicate a return to the creel of 1.3 percent for rainbow and 4.0 percent for cutthroat, during the first season they appeared in the catch.

An analysis of the estimated winter catch data shows that 89.6 percent of the catch was cutthroat trout (both marked and unmarked) and 5.4 percent eastern brook trout. The remaining 5 percent consisted of rainbow trout (both marked and unmarked), grayling, silver salmon and kokanee salmon.

The winter kokanee salmon catch dropped from an estimated 850 fish to 32 fish between the first and second periods of the winter census. No kokanee salmon were checked during the third period of the winter season. This abrupt drop in the kokanee salmon catch is attributed to the completion of the life cycle of this particular age class of kokanee salmon that had entered the fishery during the fall of 1958. It is interesting to note that kokanee salmon have never appeared on the planting record for Georgetown Lake.

A more direct proportion between average catch and average fishermen per day, per period was evident during the winter season than during the summer season. (See Figure

An estimated 22,851 more fish were harvested during the winter season than during the summer season. Of these 22,851 fish, 21,303 were cutthroat trout. A comparison between estimated total summer and winter catch by species is presented in Figure 5.

Weight average for all fish was 0.8 pounds per fish, during the summer season and 0.6 pounds per fish for the winter season. This decrease in average weight per fish during the winter season was probably due to the presence of rainbow and cutthroat trout from the 1958 plant appearing in the catch. A comparison of total weights of fish by species between the summer and winter seasons is presented in Figure 6.

The average catch per hour was 0.5 fish for the summer season and 0.8 fish for the winter. Also, a greater fluctuation in catch per hour, between periods, was evident during the summer than during the winter. Catch per hour data by periods for both summer and winter seasons are presented in Figures 8 and 9 respectively.

During the summer season, the catch per fisherman averaged 1.9 fish or 1.6 pounds, and during the winter the average catch was 3.9 fish or 2.3 pounds per fisherman.

Combined total estimates for both summer and winter seasons show that 42,628 fishermen fished for 178,193 fisherman hours and caught 117,653 game fish. Estimated total weights for both summer and winter seasons was 82,374 pounds or 41.2 tons. This weight estimate represents a yield of 29.4 pounds of fish per surface acre of the lake.

A total of 2,311 parties, or 4,801 individual anglers were contacted by creel census technicians during the summer and winter seasons.

Total estimated shore fishermen, shore fishermen contacted and percent of contact are shown by periods for the summer season on Table 5. These data are not included in the above listed totals for the lake. Estimates of effort and catch were not made for shore fishermen. The percent contact was too low to permit worthwhile total estimates to be made. The estimate of these numbers was made and included merely to illustrate that all other estimates in this report most likely are lower than the true figures.

An effort was made to collect scale samples from as many fish as possible during the summer season. However, because cutthroat trout made up such a large portion of the catch, it was not possible to obtain enough scale samples from all the other species. Three species, from which enough scale samples were obtained to be considered worthy of inclusion, were cutthroat trout, rainbow trout and grayling. Age and growth summaries for these three species are presented in Table 6. Rainbow trout had the fastest growth rate of these three species in Georgetown Lake.

Recommendations:

1. Confidence limits of boat angler estimates were not computed for this season's data because the writers felt such limits would be of little value in describing the precision of total estimates which ignored shore fishermen. However, to better evaluate the methods used, it is recommended that confidence limits be computed for the boat angler pressure and harvest estimates before this census is operated again.

2. The census study should be continued according to the following recommendations for at least a five-year period, in order to provide a suitably sound basis for the management of this lake.

    a. The same a.m., p.m., weekday, weekend day divisions of census days and criteria for setting up the census schedule as were used last year should be used again.

    b. Boat and shore angler counts should be at three-hour intervals, and arranged similarly to the counts used in periods 2 and 3.

    c. In the third period, shore angler counts (but not boat counts) should be continued until 2000.

    d. A postcard, name record, method should be employed for obtaining a sufficient number of completed-trip, catch-and-effort, contacts from shore anglers.

    e. Confidence limits should be computed for estimates based on data collected in future years.

    f. A larger and safer boat should be provided for the technicians operating the summer census.

    g. One-third of each species in each year's plant should be marked for the duration of the census.

    h. Other portions of the district work load should be adjusted so that the census technicians could receive closer supervision from permanent project personnel. This may well require that the Georgetown census be operated only in alternate years. Although this would result in the loss of data of immediate value to the management of the lake, it would extend the census in time and would likely provide as valuable data for the lake's long-term management as would a census run every year for a shorter length of time. Population sampling should be repeated yearly.

3. Management recommendations for the lake, based on previous planting records, past experience, and last year's census and survey data (see completion report for Job No. I for the survey data) are as follows:

    a. Present seasons should be continued, at least until the census has been operated another year.

b. The yearly plant should be at least 100 trout per acre (280,000 total) and these fish should be three inches or longer, when planted. From the standpoint of both biology and public relations, rainbow trout are recommended. Their growth rate is fastest (Table 6) and their ability and/or inclination to put up a more spectacular battle than the cutthroat when hooked, makes them more desirable to most anglers.

However, since Georgetown Lake is one of the sources of the Montana hatchery system's trout egg supply, its planting must be dictated by the statewide needs of that system. Therefore, the lake's planting recommendations cannot be based on what is most desirable for it alone.

The hatchery system currently needs cutthroat trout from the Georgetown Lake spawn taking stations. So, from a strictly hatchery standpoint, cutthroat trout only should be planted.

Both of the above needs could be satisfied by a plant of half of each of these species, however, again from a biological standpoint, in order to prevent hybridization, rainbow and cutthroat trout should not be planted together. Thus, a sound biological recommendation for this lake must be to plant either rainbow or cutthroat trout, but not to plant both at the same time.

Since the Georgetown cutthroat is a hybrid of various cutthroat and rainbow strains, it is recommended that its use be curtailed as fast as stocks of pure strain Yellowstone and west slope cutthroat can be built up. When such a time arrives, it is recommended the plant be changed to rainbow trout only, and the spawn taking stations operated as sources of rainbow eggs. Because of a limited spawning area which is filled with resident brook trout, and a large red-sided shiner population in the lake itself, it is expected that Georgetown Lake will continue to require annual stocking with three-inch and longer trout, in order to maintain a suitable sport fishery.

Literature or references cited:

Moyle, John B. and Donald R. Franklin, 1955. Quantitative Creel Census on Twelve Minnesota Lakes. Trans. Am. Fish. Soc., Vol. 2:85, pp. 28-38.

Weisel, George F., 1957. Fish Guide for Intermountain Montana. Mont. State Univ. Press, 88 pp.

Prepared by Robert C. Averett and Arthur N. Whitney

Approved by ________________

Date 7 July 1959

Table 1. Georgetown Lake summer creel census schedule.

Month	Period	Sa	Su	M	Tu	W	Th	F
June			29A	30A	1A	2	3P	4P
July	1	5A	6P	7	8	9	10A	11P
		12P	13A	14P	15A	16	17A	18
		19	20P	21	22	23P	24	25
		26P	27A	28A	29	30	31	
								1P
		2A	3P	4	5	6	7A	8P
August	2	9P	10A	11A	12P	13	14	15
		16A	17P	18P	19	20	21P	22
		23P	24A	25A	26	27P	28	29
		30A	31P					
				1A	2	3	4	5P
		6P	7A	8A	9P	10	11	12A
September	3	13A	14P	15	16P	17A	18P	19A
		20P	21A	22*	23	24*	25	26
		27	28*	29	30*			
						1	2	3
		4*	5	6*	7	8	9*	10
October	4	11	12*	13	14*	15	16	17*
		18*	19	20	21	22*	23*	24
		25	26	27*	28	29	30*	31

Legend: A.M. Days - A
P.M. Days - P
All Day Checks*

Period 1 - A.M. 6:00 a.m. - 4:00 p.m.
P.M. 12:00 noon -10:00 p.m.
Period 2 & 3 - A.M. 8:00 a.m. - 5:00 p.m.
P.M. 11:00 a.m. -10:00 p.m.
Period 4 - Boat counts - 8:00 a.m.-5:00 p.m.
Angler checks - 12:00 noon-dark

Table 2. Georgetown Lake winter creel census schedule.

Period	Month	Saturday	Sunday	Holiday
1	December		14*	
		20*	21	25
		27	28*	
2	January			1
		3*	4	
		10	11*	
		17*	18	
		24	25*	
		31*		
3	February-March		1	
		7	8*	12*
		14*	15*	
		21*	22*	23*
		28*		
			1*	

* Denotes days censused.

Table 3.* Estimated boats, fishermen, pressure and catch for Georgetown Lake summer creel census, 1958.

Period	Boats	Fishermen	Fishermen Hours	Rainbow No.	Rainbow Wt.	Cutthroat No.	Cutthroat Wt.
29 June 26 July	5,456	12,919	50,579	586	1,289	27,156	21,725
27 July 23 August	2,678	5,722	22,590	126	227	4,764	3,811
24 August 30 September	2,707	5,338	18,752	232	511	9,115	7,292
1 October 31 October	314	675	2,903	37	66	639	575
Totals	11,155	24,654	94,824	981	2,143	41,674	33,403

* Continued on following page.

Table 3 (cont'd). Estimated boats, fishermen, pressure and catch for Georgetown Lake summer creel census, 1958.

Eastern brook No.	Eastern brook Wt.	Grayling No.	Grayling Wt.	Silver salmon No.	Silver salmon Wt.	Kokanee salmon No.	Kokanee salmon Wt.	Total No.	Total Wt.
768	922	334	234	227	386	66	46	29,137	24,602
582	640	844	591	83	142	0	0	6,399	5,461
1,037	1,037	441	309	51	87	0	0	10,876	9,222
299	299	0	0	14	24	0	0	989	964
2,686	2,898	1,619	1,134	375	639	66	46	47,401	40,249

Table 4.* Estimated cars, fishermen, fisherman hours, catch and weight by species, by periods, for Georgetown Lake winter creel census.

Period	Cars Contacted	Fishermen	Fisherman hours	Rainbow (marked) No.	Rainbow (marked) Wt.	Cutthroat (marked) No.	Cutthroat (marked) Wt.	Rainbow No.	Rainbow Wt.
14 Dec. 31 Dec.	4,824	6,616	31,708	274	110	332	100	714	643
1 Jan. 31 Jan.	4,026	8,536	39,338	296	118	1,024	307	570	513
1 Feb. 1 March	1,381	2,822	12,323	61	24	417	125	238	214
Totals	10,231	17,974	83,369	631	252	1,773	532	1,522	1,370

Table 4 (cont'd). Estimated cars, fishermen, fisherman hours, catch and weight by species, by periods, for Georgetown Lake winter creel census.

Cutthroat		Eastern brook		Grayling		Silver salmon		Kokanee salmon		Total	
No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
24,612	14,767	1,928	1,157	164	98	24	14	850	680	28,898	17,569
27,590	16,554	1,610	966	132	79	64	38	32	26	31,318	18,601
9,002	5,401	288	173	17	10	13	8	0	0	10,036	5,955
61,204	36,722	3,826	2,296	313	187	101	60	882	706	70,252	42,125

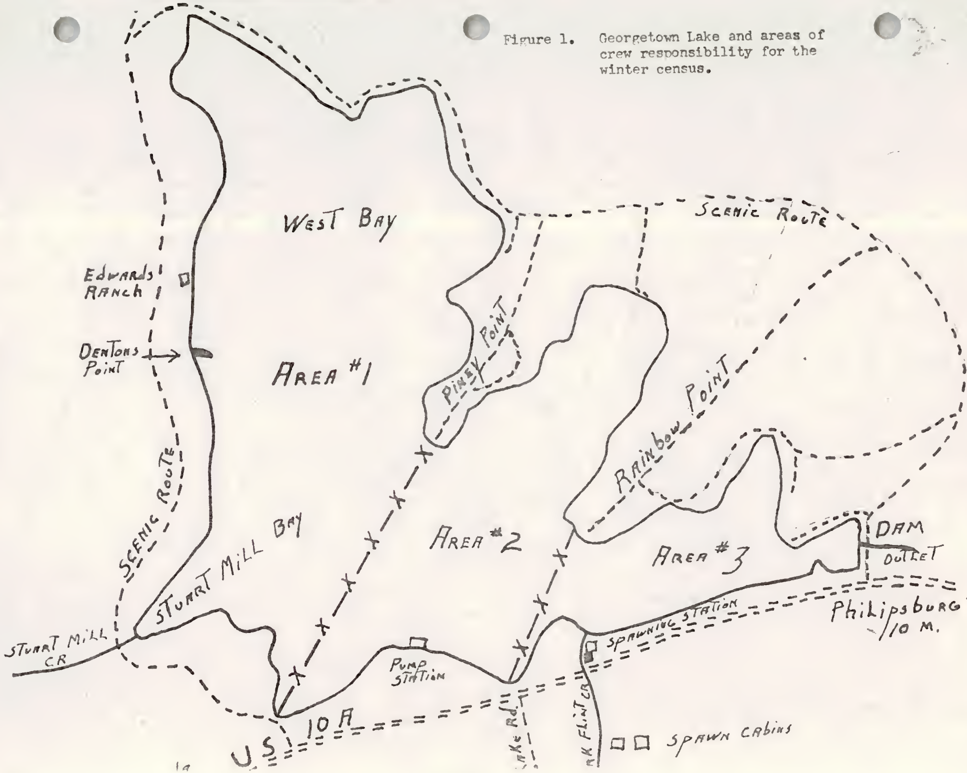
Table 5. Total estimated shore anglers, shore angler contacts and percent contact, by periods, summer season.

Period No.	1	2	3	4	Total for season
Week days	1,032	1,135	1,678	1,245	5,090
Weekend days	2,009	976	927	416	4,328
Total	3,041	2,111	2,605	1,661	9,418
Contacts	72	4	13	44	133
Percent contact	2.3	0.2	0.5	2.6	1.4

Table 6. Length, in inches, at annulus formation of cutthroat and rainbow trout and grayling. From 1958 scale samples, Georgetown Lake summer census. Numbers in parentheses indicate sample size.

	ANNULUS NUMBER				
SPECIES	I	II	III	IV	V
Cutthroat trout	3.9 (124)	9.4 (119)	13.6 (47)	16.7 (15)	23.1 (1)
Rainbow trout	6.1 (24)	13.5 (23)	15.9 (1)		
Grayling	3.4 (32)	9.4 (27)	13.0 (16)		

Figure 1. Georgetown Lake and areas of crew responsibility for the winter census.



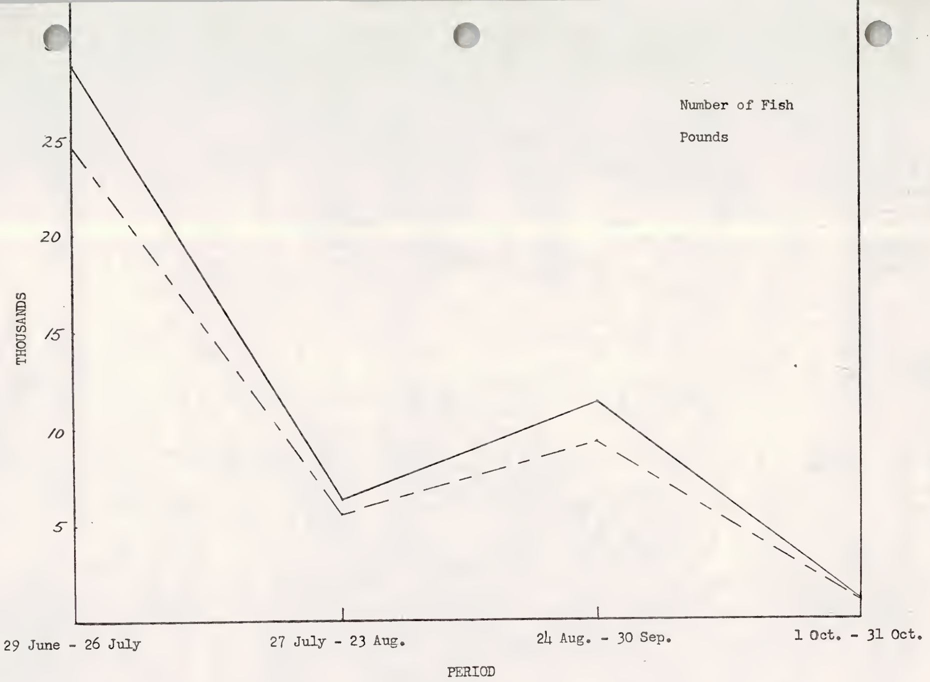


Figure 2. Comparison of numbers to weights of fish per period. Summer Census.

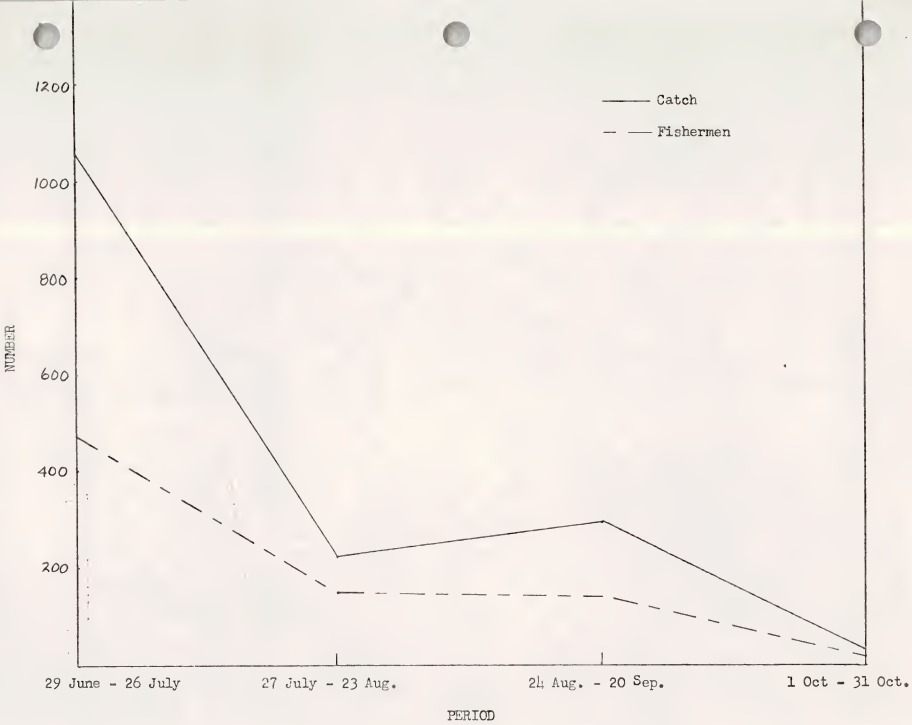


Figure 3. Average catch and Fishermen per day per period. Summer Census.

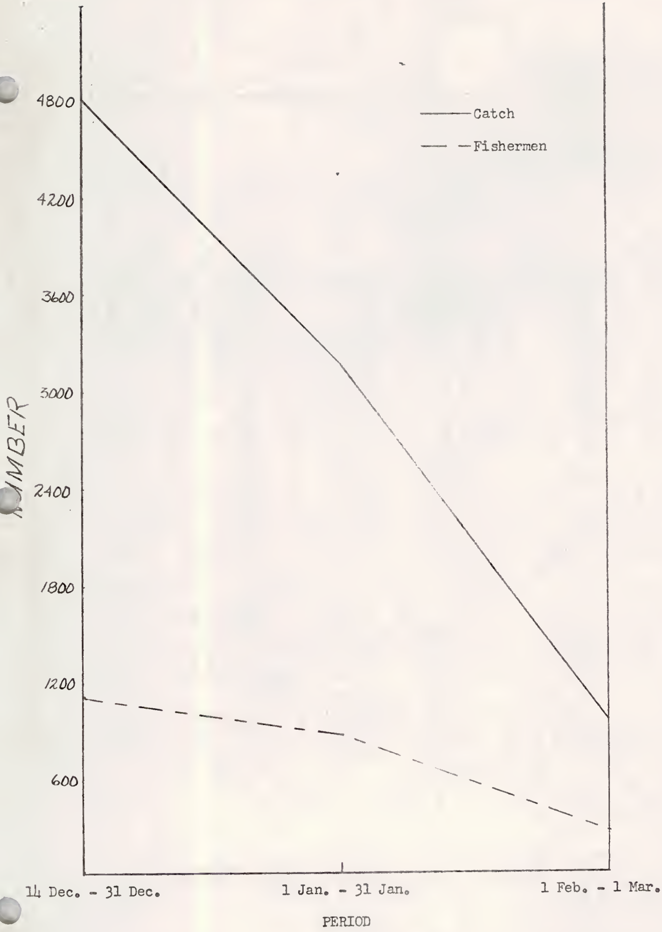


Figure 4. Average catch and fishermen per day per period. Winter Census.

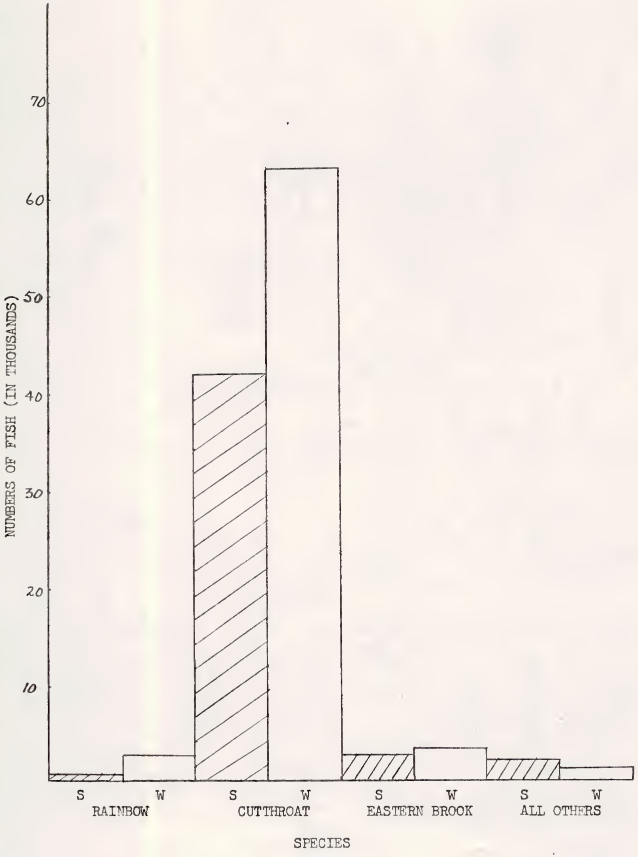


Figure 5. Comparison of numbers of fish in summer (S) and winter (W) catches, by species, from Georgetown Lake.

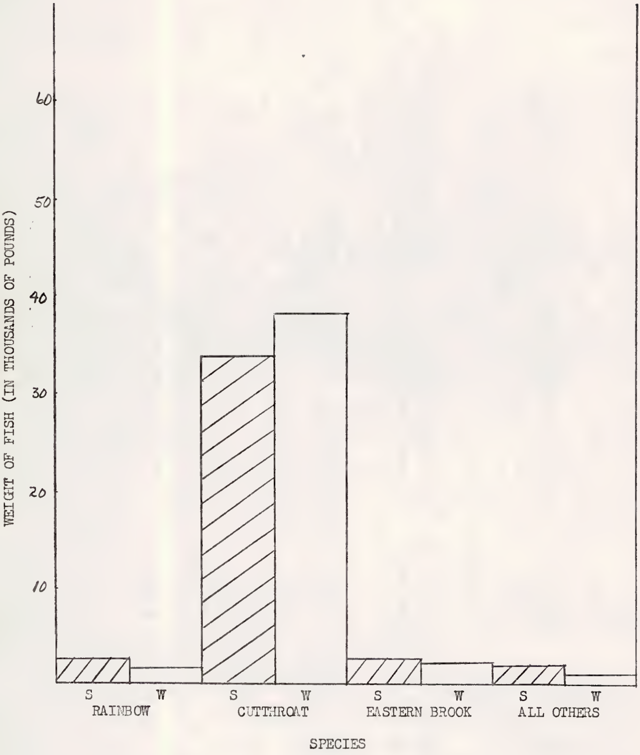


Figure 6. Comparison of weights of fish in summer (S) and winter (W) catches, by species, from Georgetown Lake.

Figure 7 Georgetown Lake census form.

GEORGETOWN LAKE CREEL CENSUS

WEATHER:

Date ____________________

Sheet __________ of __________

Censused by ______________

TOTALS

Boat
Sho
No.
Time Sta
Time End
Tot Time
Man Hou
No. Wt.
No. Wt.
No. Wt.
No. Wt.
No. Wt.
No. Wt.
No. Wt.
No. Wt.
No. Wt.
Har
Bait
Flie

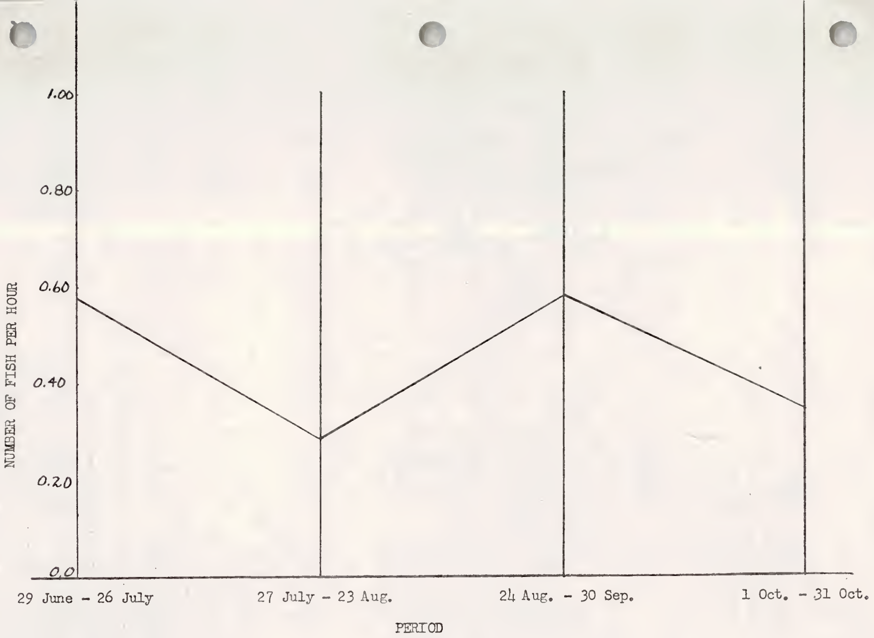


Figure 8. Average catch per hour, by periods. Summer census.

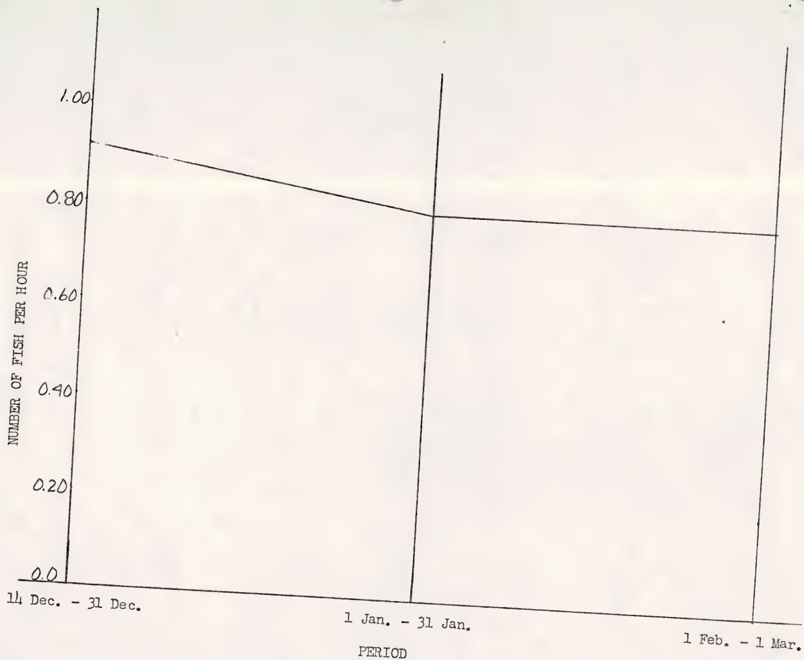


Figure 9. Average catch per hour, by periods. Winter census.

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JOB COMPLETION REPORT
INVESTIGATIONS PROJECTS

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State of: Montana

Project No: F-12-R-5 Name Western Montana Fisheries Study

Job No: II Title Rock Creek Creel Census

Period Covered: May 1, 1958 through April 30, 1959

Abstract:

A pilot model of a creel census study on a 40-mile section of Rock Creek (east of Missoula) was operated in the summer of 1958 and winter of 1958-59. The purpose of this pilot study was to determine the efficacy of certain census techniques and procedures for a detailed census on this stream section. Methods used are discussed and recommendations for a detailed census study, set up as a separate project, are made. Pressure and catch estimates, based on the pilot study, are presented. These include total estimates of: 14,800 anglers fishing for 55,300 fisherman hours, and harvesting 50,300 game fish (93% trout and 7% whitefish) from the study section during the 1958 summer angling season.

Objectives:

The stocking of catchable-sized, hatchery trout has long been used as a major fish management tool in Montana. Public sentiment has encouraged this management practice to the point where most of the larger, accessible rivers now receive annual plants of catchable-sized fish. Hatchery facilities have been increased to meet the demand for more of these fish; and at the present time, a large amount of the Montana Fish and Game Department's fishery budget is earmarked for the raising and distribution of catchable-sized trout. Although there is general agreement that this type of management will normally produce an increase in fishing success, its economic justification is somewhat questionable. Many fishery biologists now feel that a disproportionately large share of the cost of this type of planting is borne by anglers who do not benefit from it.

An evaluation of these catchable-sized trout, in regard to overwinter survival and competition with native fish, has been carried out in Montana for several years under Federal Aid project F-13-R. However, the return of these fish to the angler's creel and their harvest in relation to the wild trout harvest has never been evaluated with respect to the numbers of fish planted. Fishery managers have long recognized that such an evaluation is essential to good management, particularly since the present stocking rates of catchable-sized fish in Montana are based only on public pressure, past stocking rates, and availability of the hatchery product.

The over-all objective of a long-range, creel study on Rock Creek would be to obtain the necessary harvest and pressure information for an evaluation of the catchable-sized, trout-stocking program; certainly for Rock Creek itself, and likely with considerable application to other western Montana waters as well. Specifically,

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the objectives of this first year's pilot study were to determine if it was feasible, by a census of this type, to obtain good estimates of: (1) total pressure, total catch by species, and total number of hatchery trout taken during the general summer season; and (2) total pressure, total whitefish catch and total number of trout hooked and released during the winter "whitefish only" season.

Techniques Used:

Rock Creek, which joins the Clark Fork River about 20 miles east of Missoula, is one of the most popular and perhaps the most productive trout stream in western Montana. Approximately 40 miles of the main stream is served by a single access road -- this 40-miles section of stream was chosen for the creel study area and is shown on Figure 1. Prior to the opening of the general season on May 25, 1958, checking station sites were picked at each end of the study area and the area itself was divided into two sections by the installation of signs. Section one consisted of the lower 26 miles of the study area and section two contained the upper 14 miles. The dividing line between the sections was a road sign at Little Hogback Creek (see Figure 1). This division point was chosen because previous "spot" census and warden checks had indicated that it was somewhat of a natural boundary for anglers fishing this stream. We hoped to determine if enough anglers stayed within section boundaries to eventually permit the testing of different stocking rates or regulations on the two sections of the stream.

Pre-season advertising was carried out in the newspapers of Butte, Anaconda, Philipsburg and Missoula, Montana. Figure 2 is a sample of the advertisement used.

Portable signs were set up 1,000 feet in front of each checking station. These signs informed anglers that a creel checking station was in operation and requested them to stop at the station. When the stations were not operated, the signs were removed. One electrically-operated, pneumatically-activated car counter was placed by each census station. The census technician recorded car counts from this machine at the beginning and end of each census period and once each hour during the census period.

A total of 38,195 catchable-sized, rainbow trout was stocked in Rock Creek during the summer of 1958. Of these fish, 21,795 were planted in section 1 and 16,400 were planted in section 2. It was originally planned to mark the entire Rock Creek plant by removal of the adipose fin. But, due to a liason failure with the hatchery workers, 4,344 of these 38,195 fish were planted in an unmarked condition. However, creel census workers at both stations were able to identify many of these unmarked fish and recorded them as planted, rainbow trout.

The summer angling season was from May 25 through November 30, 1958. The prearranged census schedules, which were used for the entire summer season at stations 1 and 2, are presented in Tables 1 and 2, respectively. These tables show the period breakdowns for both stations for the summer season.

Station 1 was censused 18 Saturdays, 20 Sundays, 3 holidays, and 57 weekdays; for a total of 98 days throughout the entire summer season. Station 2 was censused 8 Saturdays, 13 Sundays, 2 holidays, and 37 weekdays, for a total of 60 days during the summer season. The lighter coverage at station 2 was made necessary by the budget limitations of this pilot study.

Table 3 shows the pre-arranged census schedule for the winter whitefish-only season. This schedule includes both census stations. The winter schedule was so arranged that one census taker could operate both stations, and as a result, both stations were never operated on the same day. This schedule was made, using the following criteria: (1) every other weekend day was worked at each station; (2) at least one weekday was worked per station per week; (3) each day of the week was

worked at least once at each station per each four-week period; and (4) no two consecutive non-census days in one week were repeated during the next week.

The lengths of the census days were varied several times throughout the summer season. However, during most of the season, a.m. and p.m. type check days were in effect. An a.m. day consisted of checking from 9:00 a.m. until 5:00 p.m., and a p.m. census day consisted of checking from 2:00 p.m. until 10:00 p.m. From October 1 until October 28 check hours were from 11:00 a.m. until 10:00 p.m. and from October 29 through November 30, 11:00 a.m. until 7:00 p.m. Fishing pressure was extremely light from October 1 through November 30, and angler contacts made by the above schedules were considered complete for the days censused.

As previously mentioned, anglers leaving the Rock Creek study area were requested to stop at the checking stations so that information regarding their catch could be recorded. Upon contacting an angler party at the station, the census taker would record the following information:

1. Time party was contacted.
2. Number of anglers in party.
3. Section in which party fished.
4. Hours fished, and fisherman hours fished.
5. Catch (recorded separately by species, and by marked hatchery trout).
6. Bait or lure used.

When time permitted, fish were weighed by species and scale samples taken from rainbow, cutthroat, Dolly Varden and brown trout.

Essentially the same information was taken from whitefish fishermen, during the winter whitefish-only season, except that anglers were requested to remember how many trout they had hooked and released while fishing for whitefish. These "trout hooked and released" data were used in an effort to determine if the winter whitefish-only season could be likely to have a detrimental effect upon the trout population.

All the above information, except the scale sample data, was recorded on a creel census form made especially for the Rock Creek creel census study. Figure 3 is a sample of this creel census form. Scale sample information was recorded on standard Montana Fish and Game Department scale sample envelopes. These scale samples, along with their recorded information, were sent to the Department's fishery laboratory at Bozeman for age and growth analysis.

Total pressure and catch estimates were derived from the contact data by (1) expanding partial day (a.m. or p.m.) contact figures to full day estimates, and (2) computing total period estimates from total census-day estimates. Data were treated separately for each census period and for each census station. Weekday and weekend-day estimates were computed separately throughout these expansion procedures, until the final step of making total estimates for the period concerned.

The first expansion step above was carried out as follows:

1. All week-day (or week-end-day) "cars contacted" data were divided into a.m. and p.m. categories.
2. Cars contacted in each of the a.m. and p.m. categories of these days were summarized separately for:
    a. Cars contacted in overlap period.
    b. Cars contacted in non-overlap period.
    c. Total cars contacted.
3. The quotient of "total cars contacted", divided by "cars contacted in overlap period", was computed for the a.m. and p.m. categories.

4. These quotients were then multiplied by the overlap car counts of each individual day of the opposite category. (The a.m. quotient by each day of the p.m. group and the p.m. quotient by each day of the a.m. group.) The resulting products (one for each individual census day of the period concerned) were considered estimates of "cars contacted in overlap period" plus cars which would have been contacted in the "missed" portion of each census day. By adding each individual day's product to the "non-overlap" portion of the cars contacted on the same day, estimates of total cars for each individual day were obtained.

Following is an algebraic description of the above described method:

Where: A = overlap portion of cars contacted in an a.m. day
B = non-overlap portion of cars contacted in an a.m. day
$A + B$ = total cars contacted in an a.m. day
X = overlap portion of cars contacted in a p.m. day
Y = non-overlap portion of cars contacted in a p.m. day
$X + Y$ = total cars contacted in a p.m. day

Then:

$$\frac{\Sigma(A + B)}{\Sigma A} \cdot X + Y$$ = Estimated total cars contacted for each individual a.m. day

$$\frac{\Sigma(X + Y)}{\Sigma X} \cdot A + B$$ = Estimated total cars contacted for each individual p.m. day

5. The estimated total cars contacted for each individual day were then divided by the actual cars contacted for the same day. This quotient was then used as a multiplier to expand the rest of the individual days' contact data (fishermen, hours, fish, etc.) to total days' estimates.

These daily estimates were expanded to period estimates by the following procedure:

1. Total census day estimate data were summed, with a.m. and p.m. days combined.
2. Total week-days (or week-end-days) ~~censused~~ in the period were divided by total week-days (or week-end-days) censused in the period. This quotient, multiplied by the summed estimated data from No. 1 above gave estimated total catch and pressure data for all week-days (or week-end-days) in the period.
3. Week-day and week-end-day total estimates were summed for total period estimates.

For the periods during which census coverage was considered complete for each day (May 25-30 and October 1-November 30) no individual, daily expansions for a.m. or p.m. portions of days were applicable, and only the steps of expanding total daily estimates to period estimates were used.

Estimates for the winter census were computed the same as for that portion of the summer season from October 1 through November 30. Census hours from 10:00 a.m. until 5:00 p.m. were considered to cover the total fishing day during this season.

As mentioned previously, creel census technicians were instructed to obtain as many weight samples of fish, by species, as possible during each period of the summer season. This weight by period method was employed so that allowance for weight increase of the fish during the summer growing season could be made. Although a large number of dressed fish were expected, we had hoped to obtain sufficient round and dressed weights to enable

us to compute a conversion factor between the two for the various species in the catch. Unfortunately, data collected by the "lumped" method of weighing (unless time was available for scale sample collections, fish were weighed by species and recorded only as total number and total weight) were found to be inadequate for obtaining any round to dressed weight conversion factors. The inadequacy was illustrated by the fact that the weight of round fish actually averaged less than that of dressed fish for some species in several periods.

We believe this could have been due to any one, or a combination of the following reasons: (1) some anglers tended to dress only their largest fish; (2) there may be a difference in the percent weight loss from dressing, between large and small fish; and (3) the number of dressed fish weighed was far larger than that of round fish. Whatever the reason for it, our inability to obtain a conversion factor for changing dressed to round weights imposes two rather serious limitations on the weight estimates presented in this report. First, the estimates had to be based on a far smaller number of fish than were actually weighed; and second, the fish which could be used for weight estimates may well have had a lower average weight than did the total catch. Methods to overcome these limitations in next year's study are suggested under "Recommendations".

The following method was used for estimating total weight of the catch:

1. A minimum of 20 fish per species for each period of the season were required for an average weight sample.
2. If 20 fish per species were not available for a period, then the total amount of fish weighed during the preceeding and following period were added to the fish weighed during the period concerned, and the average weight computed.
3. During the first period, when there was not a preceeding period, average weights were computed by addition of those fish weighed during the next period.
4. No fish were weighed at station 2 during the last period of the season. Thus, only one brown trout was checked at station 2 during the summer. This one fish was not weighed. Thus, average weight of the brown trout, checked at station 1 during the same time of the season, was used to determine the average weight of the total estimated brown trout checked at station 2.
5. Because there were too few Dolly Varden trout weighed during the summer, their weights were lumped, and an all season weight average was computed.

After computing average weights per species, per station, for each period of the summer season, these average weights were multiplied by the estimated number of fish by species taken during each period. This result gave the total estimated weights of fish by species for each period.

Average weight computation for whitefish taken during the winter whitefish-only season were computed from all whitefish weighed during the entire winter season. Anglers did not dress whitefish in the field during the winter season.

All weights were taken with a 20 pound capacity scales, registering in pounds and ounces. For the average weight computation, ounces were converted to tenths of pounds.

Findings:

Analysis of the summer creel census data shows that the following game fish species were taken by anglers in Rock Creek:

Rainbow trout	Salmo gairdneri
Cutthroat trout	Salmo clarki
Brown trout	Salmo trutta
Dolly Varden trout	Salvelinus alpinus malma
Whitefish	Prosopium williamsoni

During the summer trout season, census technicians contacted 2,762 fishermen parties, or 5,330 individual fishermen at station one. At station two, 436 fishermen parties, or 800 individual anglers were contacted.

Due to repeated mechanical failure of the car counters, the data recorded from them were not used to determine total pressure on Rock Creek. Estimated pressure data were computed as explained under the "Techniques Used" section of this report. Incomplete car counter data for stations 1 and 2 were 11,292 and 4,420 cars, respectively.

Total estimates for both stations during the summer season show that 14,841 fishermen fished for 55,324 fishermen hours, and caught 50,320 fish. Tables 4 and 5 show the estimated pressure and catch by species and periods for stations 1 and 2 respectively, for the summer season. Ninety-three percent of the fish taken were trout. The remaining 7 percent were whitefish. Percentages of total catch by species were:

Rainbow trout (wild)	38.4
Rainbow trout (hatchery)	26.4
Cutthroat trout	7.3
Brown trout	1.2
Eastern brook trout	14.6
Dolly Varden trout	5.0
Whitefish	7.0

An analysis of these data indicates that 13,284 (or 34.8 percent) of the 38,195 catchable-sized, hatchery fish planted in Rock Creek were taken by anglers during the summer season. These hatchery fish were first planted in section 2 on June 16, and in section 1 on June 17. Planting dates, and numbers of fish planted are as follows:

Date	Section	Number
June 16	2	8,000
June 17	1	5,645
June 18	1	4,800
June 27	1	4,800
July 24	2	8,400
July 28	1	6,550

A comparison of daily average catch to fishermen, by periods, for station 1 indicates that the greatest catch per fisherman per day took place during the second period of the season (June 1 to July 4). During this period, 15,242 catchable-sized rainbow trout were liberated in section 1. A graph of the comparison of average catch to fishermen for station 1, during each period of the summer season is presented in Figure 4.

The highest catch per fisherman per day from station 2 also took place during the second period (June 1 to June 30) of the summer season. During the middle of this period, (June 16) 8,000 hatchery trout were liberated in section 2. Figure 5 is a graphic illustration of the average numbers of fish and fishermen per day, by periods. The average catch and fishermen decreased by one-half between the second and third periods of the season; however, the average catch of hatchery fish per day increased slightly during this same time.

Both pressure and catch were extremely light during the last period of the season (November 1-30); and the average catch for this period was less than one fish per man per day.

During the entire summer season, the average catch per fisherman was 3.2 and 4.3 fish for stations 1 and 2 respectively. The estimated all season average catch for both stations combined was 3.4 fish per fisherman. The average length of trip for both stations combined was 3.7 hours. The average catch per man-hour of fishing time was 0.9 fish for station 1 and 1.1 fish for station 2. The average for both stations combined was 0.9 fish per hour.

Age and growth data, analyzed from scale samples collected at both stations, are presented on Table 6. These data show that brown trout had the fastest growth rate of all trout species in Rock Creek. Rainbow trout showed a slightly faster growth rate than did cutthroat and Dolly Varden trout from station 1; while cutthroat trout appeared to grow slightly faster than rainbow trout from station 2.

During the winter whitefish-only season, 210 fishermen parties and 417 individual anglers were contacted at station 1. Only 20 fishermen parties, or 40 individual anglers, were contacted at station 2.

Estimates of pressure and catch for the winter whitefish season are presented on Table 7. These data show that an estimated 1,179 fishermen caught a total of 5,165 whitefish during the winter whitefish-only season (December 1, 1958 to March 31, 1959).

Anglers were cooperative on trying to recall the number of trout, by species, hooked and released while fishing for whitefish. This estimated trout hooked and released data is also presented on Table 7.

The Montana Fish and Game Department has received considerable opposition concerning the winter whitefish season. Much of this opposition is centered around the belief that during the latter part of this season, especially during the month of March, a disproportionately large number of trout are injured by being hooked and released. The data collected during the 1958-59 whitefish season on Rock Creek do not substantiate this claim. An analysis of the winter season data reveals the following:

1. Nineteen percent of the total fishing pressure for the entire season was applied during March.
2. Twenty-one percent of the total whitefish were harvested during March.
3. Only 8 percent of the total trout were hooked and released during March.

Recommendations:

The methods used in this pilot study are applicable to an intensive creel census study on the 40-mile study section of Rock Creek. However, more intensive coverage and closer supervision of census technicians will be required than was obtained by conducting this study as one job under a district project. It is, therefore, recommended that the study be set up for an initial three-year period, as a separate research project. One project biologist, in addition to the regular district project biologists, should be in direct charge of this Rock Creek creel study. This project leader's duties should not entail the regullar manning of one of the checking stations, but should include the following:

1. Supervision of the operation of both stations, including the addition of extra help for rush periods and for experimental additions to coverage periods.

2. Responsibility for maintaining the census schedule through personnel changes.
3. Supervision of the planting operation in the study area.
4. Collection of sufficient round to dressed fish weight data from individual fish to enable the making of valid conversions of dressed fish weight records to round fish weight estimates, by species. Two possible methods are suggested: (1) angler contacts on the stream; and (2) use of fish collected during the survey, recommended under point 6 below.
5. Collection of scale samples from certain sizes of fish, not in the angler's catch; which may be required for good age and growth analysis.
6. General survey of the Rock Creek study section and its tributary streams.
7. Responsibility for collecting and filing the contact data, analysis of the data, and preparation of the completion report and future project documents.
8. Responsibility for keeping abreast of current creel census literature and the incorporation of new ideas and techniques into the study.
9. Responsibility for maintaining census equipment.
10. Responsibility for the design of future census schedules.

The following recommendations are made for the 1959-60 season:

1. The plant, which has previously been 25-35,000 rainbow for the entire 48 miles of Rock Creek, should be reduced on a stream-mile basis to 29,000 and only the study section should be planted. No hatchery fish should be liberated in the Rock Creek drainage above the study section.
2. The 1959 plant should be marked with an adipose and left pelvic fin clip.
3. The project leader should designate and be responsible for each fish plant in Rock Creek.
4. Personnel from the project should accompany the hatchery truck on each plant.
5. Census technicians should determine from anglers whether their catch was made in the main stem of Rock Creek, or from one of its tributary streams. Catches made in the tributary streams should be listed as such by a notation on the margin of the creel census form. This notation should contain the name of the tributary stream, or an abbreviation or symbol used to designate the tributary stream, where the catch was made. This information will be valuable in determining: (1) fish species in the tributary streams of Rock Creek; (2) angler pressure on the tributary streams; and (3) more accurate age and growth analysis from the main stem of Rock Creek.
6. A set of standard creel census instructions should be printed for use by Rock Creek creel census technicians. These instructions should explain exactly what information is needed, how it should be gathered, and how to record it. With such a set of instructions available, substitute census technicians could be placed on the job with a minimum of confusion and time loss. Also, census technicians would be more inclined to record all data in a similar manner.
7. A more dependable make and type of car counter, which will record hourly totals, should be used at station 1 in 1959-60 to determine its feasibility. Even though such a car counter is employed, the a.m.-p.m. division of days should also be used. If the counter proves to be accurate and reliable, its record should be used for expansion of contact data. If it does not, then the a.m.-p.m. expansion method should be used.

Prepared by Robert C. Averett and Arthur N. Whitney

Approved by George D. Holton

Date October 1, 1959

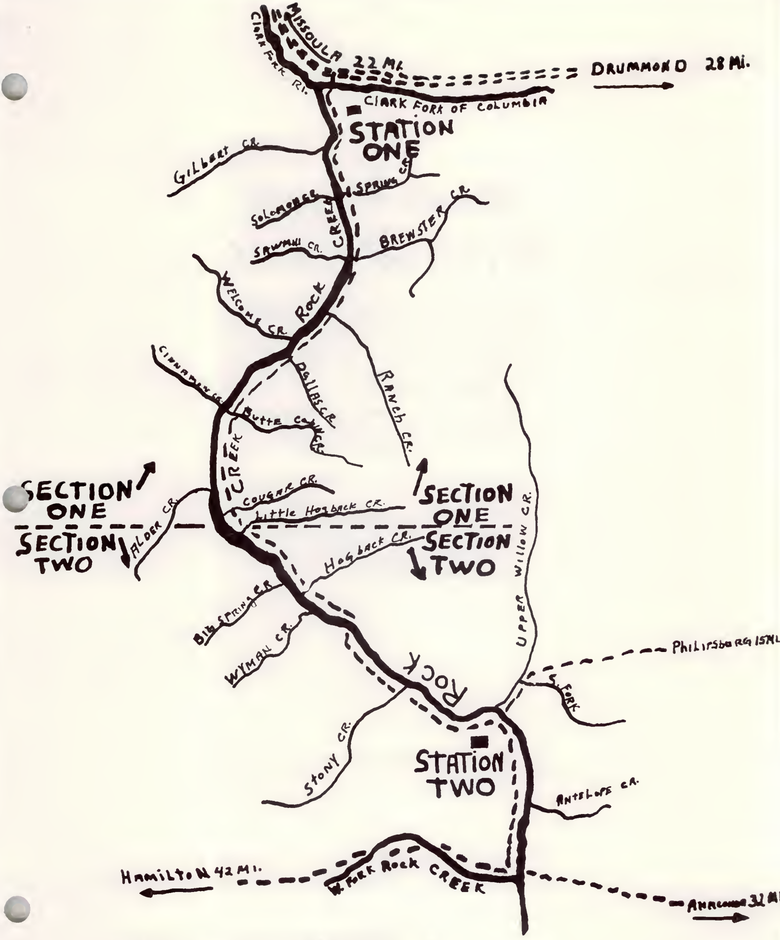

FIGURE 1. Rock Creek Project Area.

Rock Creek Fishermen!

THE FISH AND GAME DEPARTMENT WILL OPERATE CREEL CHECKING STATIONS ON BOTH ENDS OF THE ROCK CREEK ROAD THIS FISHING SEASON.

Help to insure future good fishing on Rock Creek and other Montana Streams by giving your full cooperation to the personnel at the checking stations.

For further information on this project, write to:

MONT. FISH and GAME DEPT.

FISHERIES, DIST. 2
P. O. BOX 1022
MISSOULA, MONTANA

Figure 2. Sample Advertisemt Used to Publicize Rock Creek Creel Census Study

Table 1. Summer Rock Creek Creel Census Schedule, Station 1.

Month	Period	Sa	Su	M	Tu	W	Th	F
May	1	31A	25*	26*	27	28	29	30*
June	2	7 14P 21A 28P	1P 8A 15 22P 29A	2 9A 16 23P 30	3A 10 17P 24	4 11P 18 25A	5P 12 19A 26	6 13A 20 27P
July	3	5P 12P 19 26A	6P 13 20A 27P	7P 14 21A 28P	1P 8 15A 22 29A	2 9A 16 23P 30	3P 10P 17 24A 31	4A 11 18 25
August	4	2 9P 16A 23P 30P	3A 10 17P 24A 31A	4A 11 18A 25	5 12P 19 26A	6P 13A 20 27P	7A 14 21P 28	1P 8 15P 22 29A
September	5	6P 13A 20 27P	7 14P 21A 28A	1P 8 15A 22 29P	2A 9 16P 23A 30	3 10A 17 24P	4P 11P 18 25A	5 12A 19P 26
October	6	4 11* 18 25*	5* 12 19* 26	6 13* 20 27	7 14 21* 28	1 8 15 22 29*	2* 9 16 23 30	3 10* 17 24 31
November	7	1 8* 15 22* 29	2* 9 16* 23 30*	3 10 17* 24	4 11 18 25*	5 12 19 26*	6 13* 20 27	7* 14 21 28

* Non-overlap check days.
A=a.m. check - 9 a.m. to 5 p.m.
P=p.m. check - 2 p.m. to 10 p.m.

Table 2. Summer Rock Creek Creel Census Schedule, Station 2.

Month	Period	Sa	Su	M	Tu	W	Th	F
May	1	31A	25*	26*	27	28	29	30*
June	2	7 14 21A 28	1P 8 15 22P 29	2 9 16 23P 30	3A 10 17 24	4 11P 18 25	5 12 19A 26	6 13 20 27P
July	3	5 12 19 26A	6 13 20 27P	7 14 21P 28P	1A 8 15 22 29A	2 9A 16 23P 30	3 10 17 24A 31	4 11 18P 25
August		2 9 16A 23 30P	3 10 17P 24 31A	4 11 18A 25	5 12 19 26P	6P 13A 20 27P	7 14 21 28	1 8 15 22 29
September	4	6 13A 20 27	7 14P 21A 28	1P 8 15A 22 29P	2 9 16 23 30	3 10A 17 24	4P 11P 18 25A	5 12 19P 26P
October		4 11* 18 25*	5* 12 19* 26	6 13* 20 27	7 14 21* 28	1 8 15 22 29*	2 9 16 23 30	3 10* 17 24 31
November	5	1* 8 15* 22 29*	2 9* 16 23* 30	3 10* 17 24	4* 11 18 25	5 12 19* 26	6 13 20* 27	7 14 21 28

* = Non-overlap check days.
A = a.m. check days - 9 a.m. to 5 p.m.
P = p.m. check days - 2 p.m. to 10 p.m.

Table 3. Combined Creel Census Schedule for Stations 1 and 2, Rock Creek Winter Whitefish Only Season.

Month	Period	Su	Su	M	Tu	W	Th	F
				1	$\underline{2}$	3	(4)	(5)
		(6)	$\underline{7}$	$\underline{8}$	9	(10)	11	(12)
December		$\underline{13}$	(14)	(15)	16	$\underline{17}$	$\underline{18}$	19
		(20)	$\underline{21}$	22	(23)	24	25	$\underline{26}$
		$\underline{27}$	(28)	29	$\underline{30}$	31		
	1						(1)	2
		(3)	$\underline{4}$	$\underline{5}$	6	(7)	8	(9)
		$\underline{10}$	(11)	(12)	13	$\underline{14}$	$\underline{15}$	16
January		(17)	$\underline{18}$	19	(20)	21	22	$\underline{23}$
		$\underline{24}$	(25)	26	$\underline{27}$	28	(29)	30
		(31)						
			$\underline{1}$	$\underline{2}$	3	(4)	5	(6)
		$\underline{7}$	(8)	(9)	10	$\underline{11}$	$\underline{12}$	13
February		(14)	$\underline{15}$	16	(17)	18	19	$\underline{20}$
		$\underline{21}$	(22)	23	$\underline{24}$	25	(26)	27
		(28)						
	2							
			$\underline{1}$	$\underline{2}$	3	(4)	5	(6)
		$\underline{7}$	(8)	(9)	10	$\underline{11}$	$\underline{12}$	13
March		(14)	$\underline{15}$	16	(17)	18	19	$\underline{20}$
		$\underline{21}$	(22)	23	$\underline{24}$	25	(26)	27
		(28)	$\underline{29}$	$\underline{30}$	31			

__ Upper station.
( ) Lower station.

ROCK CREEK CREEL CENSUS | Car Counter Reading | Water Temp. | Weather

Date________________ | Start__________at________hrs. | Max._____°F | ____-1200:____________________

Sheet______of________ | End___________at________hrs. | Min._____°F | 1200-1800:____________________

1800-____:____________________

CATCH

Car No.	Time	F'men	S	F'man Hrs.	RB*		RB		CT		EB		WF		OTHER			OTHER			OTHER			Type Lure		
					N	W	N	W	N	W	N	W	N	W	SP	N	W	SP	N	W	SP	N	W	H	B	F
1																										
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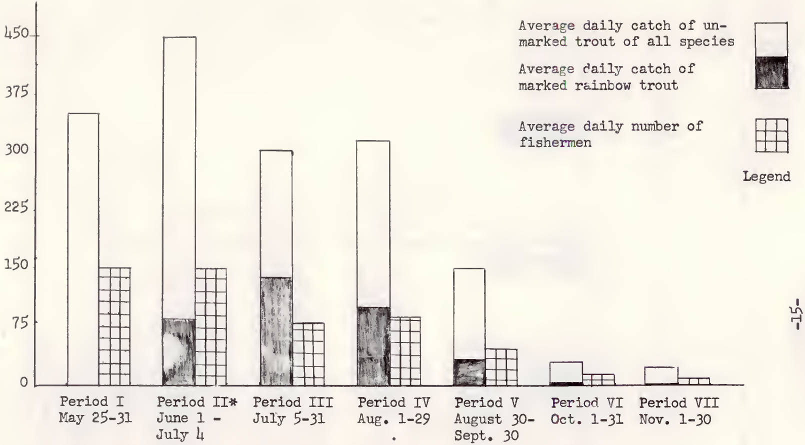
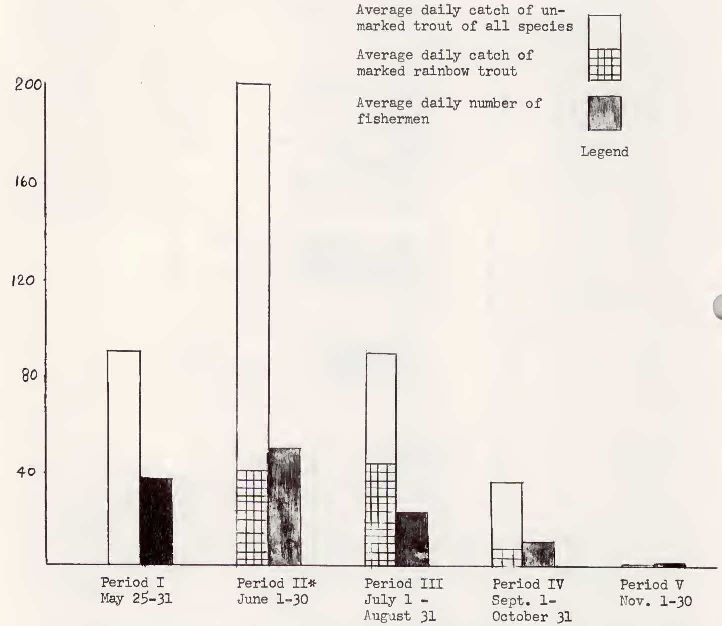
Figure 3. Census Form Used on Rock Creek Creel Census



* Hatchery (marked) trout contributed to the total harvest for only 18 days during Period II, but the average catch is calculated for the entire period.

Figure 4. Average number of fishermen and average total catch per day, per period, Rock Creek Creel Census, Station 1, summer census, 1958.



* Hatchery(marked) trout contributed to the total harvest for only 15 days during Period II but the average catch is calculated for the entire period.

Figure 5. Average number of fishermen and average total catch per day, per period, Rock Creek Creel Census, Station 2, summer census, 1958.

Table 4.* Estimated Pressure and catch for summer fishing season, Rock Creek station 1.

Period	Cars Contacted	Fishermen	Fisherman Hours	Rainbow No.	Rainbow Wt.	Rainbow (marked) No.	Rainbow (marked) Wt.	Cutthroat No.	Cutthroat Wt.
25 May 31 May	426	811	3,252	1,184	710	0	0	172	52
1 June 4 July	2,368	4,615	16,851	5,557	3,334	2,691	807	537	161
5 July 31 July	1,003	1,913	7,099	2,094	838	3,387	1,016	351	105
1 August 29 August	1,237	2,326	9,012	3,862	1,931	2,640	528	447	134
30 August 30 September	718	1,317	4,413	2,014	1,007	855	171	285	57
1 October 31 October	223	367	1,023	290	145	56	11	40	8
1 November 30 November	81	149	330	144	72	12	2	5	1
TOTAL	6,056	11,498	41,989	15,145	8,037	9,641	2,535	1,837	518

* Continued on following page.

Table 4 (cont'd). Estimated pressure and catch for summer fishing season, Rock Creek Station 1.

Eastern brook		Dolly Varden		Brown trout		Whitefish		Total	
No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
244	49	101	60	37	74	188	150	1,926	1,095
2,331	466	872	523	254	508	543	434	12,785	6,233
878	175	361	181	67	134	140	112	7,278	2,561
730	146	277	139	152	304	208	166	8,316	3,348
542	108	128	64	62	124	236	189	4,122	1,720
64	13	32	16	39	78	289	231	810	502
0	0	5	3	12	24	429	343	607	455
4,789	957	1,776	989	623	1,246	2,033	1,625	35,844	15,904

Table 5.* Estimated pressure and catch for summer fishing season, Rock Creek Station 2.

Period	Cars Contacted	Fishermen	Fisherman Hours	Rainbow No.	Rainbow Wt.	Rainbow (marked) No.	Rainbow (marked) Wt.	Cutthroat No.	Cutthroat Wt.
25 May 31 May	97	181	599	158	79	0	0	83	25
1 June 30 June	675	1,359	5,306	1,714	857	915	275	694	208
1 July 31 August	611	1,262	5,731	1,916	575	2,483	497	586	175
1 September 31 October	269	521	1,649	369	111	266	53	478	95
1 November 30 November	10	20	50	0	0	0	0	0	0
TOTAL	1,662	3,343	13,335	4,157	1,622	3,664	825	1,841	503

* Continued on following page.

Table 5 (cont'd). Estimated pressure and catch for summer fishing season, Rock Creek Station 2.

Eastern brook		Dolly Varden		Brown trout		Whitefish		Total	
No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
170	51	33	17	0	0	83	25	527	197
1,590	318	299	149	3	6	718	215	5,933	2,028
508	152	258	129	0	0	233	70	5,984	1,598
291	58	167	84	0	0	447	134	2,018	535
0	0	2	1	0	0	12	4	14	5
2,559	579	759	380	3	6	1,493	448	14,476	5,570

Table 6. Age and growth analysis, stations 1 and 2, Rock Creek summer creel census.

	ANNULUS					
Species	I	II	III	IV	V	VI
Rainbow trout	2.8 (147)	6.9 (140)	11.0 (78)	13.7 (36)	16.1 (6)	17.0 (2)
Cutthroat trout	2.7 (78)	6.3 (72)	9.7 (23)	12.4 (4)	15.4 (2)	
Dolly Varden trout	3.5 (35)	6.7 (35)	9.6 (32)	12.9 (5)		
Brown trout	3.5 (31)	8.5 (21)	12.9 (9)			
			STATION 2			
Rainbow trout	2.7 (118)	6.5 (113)	10.1 (66)	12.6 (19)	15.6 (3)	
Cutthroat trout	2.7 (60)	6.5 (58)	10.2 (14)	14.1 (1)		

Numbers in parentheses indicate sample size.

Table 7. Total estimated pressure and catch, with trout hooked and released during Rock Creek winter whitefish season, on Station 1 and 2.

STATION 1

Period	Cars Contacted	Fishermen	Fisherman Hours	Whitefish No.	Whitefish Wt.	Rb*	Trout hooked and Released Rb	Ct	Eb	DV	L.L.
December 1 February 1	317	601	1,817	2,498	999	4	370	12	41	8	55
February 2 March 31	236	445	1,218	1,991	796	0	205	4	30	6	17
Total	553	1,046	3,035	4,489	1,795	4	575	16	71	14	72
STATION 2											
December 1 February 1	29	65	171	212	85	0	0	0	0	0	0
February 2 March 31	34	68	202	464	186	0	5	0	0	0	0
Total	63	133	373	676	271	0	5	0	0	0	0
GRAND TOTAL	616	1,179	3,408	5,165	2,066	4	580	16	71	14	72

Rb* = Marked rainbow trout
Rb = Rainbow trout
Ct = Cutthroat trout
Eb = Eastern brook trout
DV = Dolly Varden trout
L.L.= Brown trout

MONTANA STATE DEPARTMENT OF FISH AND GAME
FEDERAL AID IN FISH RESTORATION SECTION
HELENA, MONTANA

JOB COMPLETION REPORT
INVESTIGATIONS PROJECTS

State of Montana

Project No. F-12-R-5 Name Western Montana Fishery Study

Job No. I Title Inventory of the Waters of the Project Area

Period Covered May 1, 1958 - April 30, 1959

Abstract:

Thirty-eight mountain lakes and six streams were surveyed during the summer of 1958. Locations of waters, population sampling effort and fish captured are presented in tabular form. Planting recommendations are given for waters considered worthy of that type of management effort. Temperature readings and down-migrant trap catches are presented for the North Fork of Flint Creek. Population sampling was repeated in Inez, Alva and Rainy Lakes in the Clearwater drainage. Fiducial limits of the average catches per net night from these lakes are listed. Recommendations are made for future lake and stream surveys.

Objectives:

To catalog some of the waters in the project area and to determine their value in the overall fishery management picture. Specifically, the objective of the high-lake surveys was to determine the value of continued or future stocking in some of the high lakes in the Bighole, Bitterroot and Clark Fork drainages, that are now being regularly stocked with hatchery trout. The Georgetown Lake survey was a special case because a creel census was planned on this lake during the summer and winter of 1958 and 1959. Thus, it was desirous to know the species composition, lake size and other physical features of the lake prior to the initiation of the creel census.

The objectives of the stream surveys were as follows: determine present fishery value and species composition prior to channel changing by road constructing agencies -- Joseph and Trail Creeks; determine the need for stocking hatchery trout as requested by the public -- Deep, Twelve Mile and Ten Mile Creeks; determine available spawning area -- North Fork of Flint Creek.

Techniques Used:

During June, July and August, 1958 a total of 38 mountain lakes were surveyed by project personnel. Twenty-seven of these 38 lakes were accessible by trail only and, therefore, pack stock (horses) were utilized to get men and equipment to them. The remaining 11 lakes were accessible by either two or all-wheel drive vehicles.

Those lakes that were considered worthy of fishery investigation, were gill netted with 125-foot, experimental gill nets having graduated stretch mesh sizes from $1\frac{1}{2}$ to 4 inches. A hand line was used to determine the maximum depth, and the location of the shoal areas of each lake. Sketch maps were drawn of each lake surveyed. This sketch map showed the relative location of the net sets made in the lake, principal aquatic plant beds, tributary and outlet streams, and other important physical features of the lake.

Fish taken in gill nets were sorted as to species, counted, weighed and measured. Scale samples were taken from all trout. These scale samples were forwarded to the Department's fishery laboratory for age and growth analysis. Other gross physical features of each lake were recorded on the Montana Fish and Game Department's standard Lake Survey Form.

Due to its importance as a trout fishery, and because a creel census was being planned for it, Georgetown Lake was surveyed more thoroughly than all other lakes under consideration in this report. A large scale outline map of this lake was pantographed from aerial photographs. A Bendix Depth Recorder, mounted on an outboard motor boat, was used to sound the lake. From the sounding data thus collected, contour lines were drawn on the outline map. Areas of these contours were planimetered and total volume was computed.

A total of 30, 125-foot, overnight gill net sets were made in Georgetown Lake between June 23 and June 27, 1958.

Except for the North Fork of Flint Creek, stream surveys consisted of shocking one or more representative section of each stream with a 220 volt A.C. shocking device. Each stream section so chosen was blocked off at each end with nets. "Shocked" fish were retrieved with insulated dip nets. All fish thus collected were counted, weighed, measured, and scale samples were taken from all trout. These scale samples were sent to the Department's fishery laboratory for age and growth analysis. Gross physical characteristics of each stream were recorded on the Montana Fish and Game Department's standard Stream Survey Form.

The North Fork of Flint Creek, a tributary to Georgetown Lake, was surveyed in an effort to determine its suitability as a spawning stream for trout species in Georgetown Lake. A five mile section of this stream--from Echo Lake to Georgetown Lake--was walked and sketch mapped. Potential spawning areas were noted on the sketch map, and all observed fish species were listed. A standard Stream Survey Form was filled out for this section of the stream.

On July 8, 1958 a minimum-maximum thermometer was submerged in the North Fork of Flint Creek approximately one-quarter mile from its mouth. Temperatures from this thermometer were recorded a total of 48 times between July 9 and September 30, 1958.

A down-migrant fry trap was placed in the North Fork of Flint Creek, near the above mentioned thermometer, and was "fished" for 10 different nights between July 27 and August 20, 1958. This trap, which covered one-half of the stream width, was installed between 6:00 and 10:00 p.m. in the evening and removed the following morning between 7:00 and 10:00 a.m. Fry thus collected were counted and preserved for future identification and examination.

Population sampling was continued for the fourth consecutive season on Inez, Alva and Rainy Lakes, in the Clearwater drainage. Standard net sets were made in the same locations in these lakes as in previous years. Fish captured were weighed, measured and recorded by species. Catch data was summarized for average catch per net night by species and the fiducial limits of these catch figures were computed at the ninety-five percent level.

Findings:

Table 1 lists the lakes surveyed during 1958, their location and summary of net catch data.

Of the 18 lakes surveyed in the Bighole drainage, 11 were impounded for irrigation water storage. These lakes are marked with asterisks on Table 1. Dams on these lakes ranged from 8 to 20 feet in height. The stored water is used for late summer agricultural irrigation.

Two of the five lakes surveyed in the Bitterroot drainage during 1948 are impounded, the stored water being used for late summer agricultural irrigation. The two impounded lakes are Como and Lower Twin.

Fifteen lakes were surveyed in the Clark Fork drainage during 1958. These lakes are listed in Table 1.

A total of six streams were surveyed during the summer of 1958. Table 2 lists these streams, along with their size and fish species captured. Of these six streams, only three were surveyed for purposes of determining if they should be stocked with hatchery trout. These streams were: Deep, Ten Mile, and Twelve Mile Creeks.

Trail and Joseph Creeks were surveyed to determine their present fish species composition, and to evaluate them as a fishery prior to some proposed channel changes by the U. S. Bureau of Public Roads.

The Joseph Creek survey revealed that this stream has a predominant population of small eastern brook trout. Its overall fishery value is relatively small. Trail Creek, a tributary to the Bighole River, also has a predominant population of eastern brook trout. However, this stream is easily accessible because of an earth road along most of its length. Its fishery value is considered relatively high.

The North Fork of Flint Creek, a tributary to Georgetown Lake, was surveyed for purposes of determining its use as a potential spawning stream for trout species in Georgetown Lake. This stream flowed throughout the year in 1958. In previous years, it has become dry during the latter part of the summer.

A minimum-maximum temperature station was installed in this stream and temperatures were recorded a total of 48 times between July 9 and September 30, 1958. Table 3 lists the temperature readings and the dates they were taken. All temperatures were recorded between 7:00 and 9:00 a.m. on the days listed.

A down-migrant fish trap, which covered one-half of the stream width was placed in the North Fork of Flint Creek a total of 10 times between July 27 and August 20, 1958. Table 4 lists the periods that the trap was "fished" and the amount of down-migrant fry taken for each period. This trap was "fished" for a total of 119 hours, and 983 down-migrant fry were captured. Although not all of the fry thus captured have been sorted to species at the time of this writing, most of them appear to be cutthroat trout. This is plausible because of the large cutthroat trout population in Georgetown Lake.

The average catch per net night by species, and the fiducial limits of these figures at the 95% level are given on Table 5 for Inez, Alva and Rainy Lakes. These are repeated for the nine most numerous species in the catches on Tables 6 and 7, along with the same information from the 1955, 1956 and 1957 seasons on these lakes. Note that no significant changes have occurred for any of the game species in these lakes during the four years of sampling. A large, significant increase in the catch of yellow perch from Alva Lake occurred in 1958.

Recommendations:

The following survey recommendations are made:

1. Flow measurements in cubic feet per second should be made in the North Fork of Flint Creek periodically throughout the summer months for a period of at least five years.

2. Impounded lakes should be surveyed or re-surveyed at the period of extreme drawdown.

3. To aid in the evaluation of the rehabilitation of Rainy Lake (treated under Project F-24-D-13 in September, 1958), this lake, Alva and Inez should be sampled again after a fish population has been re-established in Rainy. This will likely be in the summer of 1961.

The following stocking recommendations are made:

1. Stocking or other management recommendations should be made only after the lake has been surveyed at extreme low water.

2. Lakes that presently do not have fish in their waters should be left in such a state for future management, unless such a lake could be deemed important to the immediate fishery needs of the surrounding area.

3. No lakes should be stocked with hatchery trout unless they are first surveyed.

4. Only five of the 18 lakes surveyed in the Bighole drainage are recommended for continued or further stocking with hatchery trout. These five lakes are Bond, Boot, Deerhead, Pear, Rainbow and Waukena. Either rainbow or cutthroat trout are recommended for stocking Boot and Pear Lakes, and cutthroat trout only are recommended for stocking Deerhead and Rainbow Lakes. Golden trout are recommended for stocking in Waukena Lake.

5. The remaining 13 lakes surveyed in the Bighole drainage are not recommended for trout stocking at this time.

6. Of the five lakes surveyed in the Bitterroot drainage, Lower Twin is recommended for continued stocking with cutthroat trout. The remaining four lakes surveyed in this drainage are not recommended for trout stocking at this time.

7. Of the 15 lakes surveyed in the Clark Fork drainage during 1958, nine are recommended for continued or future stocking with hatchery trout. These nine lakes are: Upper Barker, Cliff, Georgetown, Meadow Lakes 1,2,4,5, Big Racetrack, and Storm. Rainbow trout is the fish species recommended for stocking in these nine lakes.

Georgetown Lake, which has a predominantly cutthroat population, is recommended for stocking with rainbow trout for the following reasons:

a. Public opposition to the present cutthroat management.
b. The fishery's apparent dependence upon artificial stocking of advanced trout fingerlings. This is believed due to a shortage of spawning area and the large redside shiner population in the lake.
c. The lake's accessibility - it is on an oiled highway.

The remaining six lakes surveyed in the Clark Fork drainage are not recommended for trout stocking at this time.

8. Both Deep and Ten Mile Creeks are recommended for annual stocking with rainbow trout. Due to its small size and lack of adequate accessibility, Twelve Mile Creek is not recommended for stocking.

It is believed that mountain lakes, because of their relative inaccessibility, support only a small portion of the total fishing pressure in the project area at present. However, the ease with which they may be planted from the air, and the attitude of the large segment of the general public who regard planting as a panacea for all fishing ills, results in pressure to plant mountain lakes even before they have been investigated to determine the need and even possible harm that could be done.

It is, therefore, imperative that some mountain lakes within the project area be surveyed each year and the worthy ones put on the planting program. It is not expected that such a mountain lake survey program will result in the elimination of all unnecessary plants. We hope, however, to accomplish the following:

1. Eliminate the potentially harmful plants.
2. Retain the plants which are producing fishing.
3. Add plants where they are deemed necessary.
4. Continue cataloging the waters of the project area.
5. By the fishing produced under points 2 and 3 above, reduce the pressure for a "plant everything" program.

The overall objective may be summarized as follows: Even though present fishing pressure does not warrant it, a regular schedule of mountain lake surveys should be initiated in order to retain a potential in our mountain lake fishery, which may be used in the future when these waters do become essential to the fishery of the project area.

Two months' time for a two-man, pack-string-equipped crew was spent in 1958 to survey 32 of the mountain lakes covered in this report. Survey emphasis was on the Bighole and upper Clark Fork drainages. It is recommended that a minimum of one month be spent on mountain lake survey in the western district by the same type of crew each field season. Survey emphasis should be on lakes in the Bitterroot and Blackfoot drainages in 1959.

With over 300 mountain lakes in the project area, this job will likely never be entirely completed. Because present pressures to plant are usually on the better, more accessible lakes, surveys should also be initiated on those waters. Although this is less economical of time than total survey of a drainage or sub-drainage, our primary objective is to insure proper management of our mountain lake resource, so it will be available for future generations. We should, therefore, concentrate our efforts on the most important parts of that resource.

Prepared by R. C. Averett and A. N. Whitney   Approved by George D. Holton

Date April 1, 1959

Table 1. Lakes surveyed and summary of net catch data (lakes listed alphabetically by drainage).

Lake	Location	Drainage	County	Total Net Sets	Total Net hrs.	Species	No.
* Agnes	T4S R10W S4	Bighole	Beaverhead	2	20	Grayling	10
* Anchor	T5S R11W S5	Bighole	Beaverhead	2	36	No catch	0
* Bond	T4S R10W S32	Bighole	Beaverhead	1	19	Cutthroat	2
						Eastern brook	5
* Boot	T2S R11W S4	Bighole	Beaverhead	2	47	Cutthroat	1
						Rainbow	8
						Grayling	1
* Chan	T5S R11W S6	Bighole	Beaverhead	None	None	None	0
Continental	T1N R16W S10	Bighole	Beaverhead	None	None	None	0
Crystal	T1N R16W S2	Bighole	Beaverhead	1	24	Rainbow	10
* Deerhead	T4S R11W S35	Bighole	Beaverhead	1	24	Cutthroat	4
Lion	T1N R16W S15	Bighole	Beaverhead	3	48	No catch	0
Long	T3S R10W S31	Bighole	Beaverhead	None	None	None	0
* May	T5S R11W S6	Bighole	Beaverhead	1	22	Cutthroat	0
Mosquito	T1N R16W S10	Bighole	Beaverhead	None	None	None	0
Mystic	T1N R16W S2	Bighole	Beaverhead	1	24	Rainbow	20
* Pear	T5S R11W S5	Bighole	Beaverhead	2	55	Cutthroat	3
Rainbow	T4S R10W S5	Bighole	Beaverhead	1	24	No catch	0
* Tendoy	T4S R11W S4	Bighole	Beaverhead	None	None	None	0
* Tub	T5S R11W S8	Bighole	Beaverhead	1	22	No catch	0

(cont'd)

* Denotes impounded lake.

Table 1. (cont'd)

Lake	Location	Drainage	County	Total Net Sets	Total Net hrs.	Species	No.
* Waukena	T3S R11W S27	Bighole	Beaverhead	2	48	No catch	0
* Como	T3N R21W S31	Bitterroot	Ravalli	18	388	Rainbow	5
						Whitefish	21
						Squawfish	71
						Fine-scaled sucker	47
						Coarse-scaled su.	141
						Columbia River chub	38
Hope	T1N R16W S9	Bitterroot	Ravalli	1	26	Rainbow	2
* Twin (lower)	T5N R23W S29	Bitterroot	Ravalli	4	77	Cutthroat	35
						Rainbow	2
No-name	T2N R16W S32	Bitterroot	Ravalli	None	None	None	0
No-name	T2N R16W S33	Bitterroot	Ravalli	None	None	None	0
Barker (upper)	T4N R12W S17	Clark Fork	Deerlodge	None	None	None	0
Barker (lower)	T4N R12W S17	Clark Fork	Deerlodge	1	21	Rainbow	5
Cliff	T6N R28W S18	Clark Fork	Mineral	4	35	Rainbow X Cutthroat	6
* Fisher	T6N R12W S4	Clark Fork	Granite	2	38	Cutthroat	13
						Rainbow	2
* Georgetown	T5N R14W S23	Clark Fork	Deerlodge	30	619	Cutthroat	458
						Rainbow	10
						Eastern brook	77
						Silver salmon	3
						Grayling	10
						Fine-scaled su.	2064
						Red-sided shiner	124
Meadow #1	T6N R12W S2	Clark Fork	Granite	1	22	Rainbow	5

(cont'd)

* Denot[illegible] impounded lake.

Table 1. (cont'd)

Lake	Location	Drainage	County	Total Net Sets	Total Net hrs.	Species	No.
Meadow #2	T6N R12W S2	Clark Fork	Granite	1	17	Rainbow	1
Meadow #3	T6N R12W S3	Clark Fork	Granite	1	22	Rainbow	1
Meadow #4	T6N R12W S4	Clark Fork	Granite	2	44	Rainbow	1
Meadow #5	T6N R12W S10	Clark Fork	Granite	1	27	No catch	0
Meadow #6	T6N R12W S10	Clark Fork	Granite	None	None	None	0
Moore	T16N R29W S3	Clark Fork	Mineral	2	39	Rainbow	1
						Eastern brook	49
* Racetrack (Big)	T6N R12W S5	Clark Fork	Granite	4	79	Rainbow	23
Silver	T19N R31W S32	Clark Fork	Mineral	5	95	Eastern brook	92
* Storm	T4N R13W S3	Clark Fork	Deerlodge	2	39	Cutthroat	31
						Rainbow	16

* Denotes impounded lake.

Table 2. Streams surveyed and summary of electro-fishing data (streams listed alphabetically by drainage.)

Stream	Drainage	CFS	Sections sampled	Total length all sections	Species	Number
Deep Creek	Bighole	± 20	1	200 feet	Eastern brook	7
T2N R12W S17					Cutthroat	4
Deerlodge					Cottus	14
					Ling	1
					Dace	1
					Fine-scaled sucker	6
Joseph Creek	Bighole	± 5	2	400 feet	Eastern brook	117
T2S R18W S16					Cutthroat	2 **
Beaverhead					Cottus	25
Ten Mile Creek	Bighole	± 10	1	200 feet	Eastern brook	33
T3N R12W S4					Cutthroat	1
Deerlodge					Cottus	16
					Fine-scaled sucker	2
Trail Creek	Bighole	± 10	1	150 feet	Eastern brook	13
T2S R17W S23					Ling	1
Beaverhead					Dace	3
					Cottus	7
Twelve Mile Creek	Bighole	± 4	1	200 feet	Eastern brook	11
T3N R12W S17					Cutthroat	18
Deerlodge					Cottus	17
N. F. Flint Creek	Clark Fork	± 5	none	none	Eastern brook *	Not recorded
T5N R13W S7					Cutthroat *	Not recorded
Deerlodge					Red-sided shiner*	Not recorded

* Observed
** Taken by angling

Table 3. Minimum-maximum temperature readings for the North Fork of Flint Creek. (All temperature readings in degrees Fahrenheit).

Month	Day	Minimum	Maximum	Month	Day	Minimum	Maximum
July	9	50	58	August	10	54	62
	10	50	61		12	60	64
	11	51	61		13	53	66
	12	52	63		14	52	65
	14	49	63		16	52	66
	15	46	56		17	52	66
	16	45	61		20	53	65
	18	53	64		21	54	65
	19	50	58		22	54	65
	20	50	58		24	52	64
	21	52	62		25	52	63
	22	52	62		27	52	64
	23	56	64		28	52	63
	24	55	63		29	52	62
	25	54	65		31	47	61
	26	54	62				
	27	54	62	September	5	44	59
	28	54	63		6	44	59
	29	54	65		9	47	60
					11	42	61
August	3	52	62		18	44	62
	5	51	60		20	44	56
	6	52	62		24	38	55
	9	54	63		30	40	52

Table 4. Down-migrant fry taken in trap on North Fork of Flint Creek, 1958 (trap covered one-half of stream width).

SET Date	SET Time	LIFTED Date	LIFTED Time	Total hrs. "fished"	Number Fry
July 25	9 p.m.	July 26	7 a.m.	10	60
July 27	10 p.m.	July 28	8 a.m.	10	27
August 1	10 p.m.	August 2	10 a.m.	12	139
August 2	7 p.m.	August 3	8 a.m.	13	181
August 3	10 p.m.	August 4	9 a.m.	11	380
August 7	6 p.m.	August 8	8 a.m.	14	114
August 12	7 p.m.	August 13	7 a.m.	12	10
August 13	7 p.m.	August 14	8 a.m.	13	27
August 16	8 p.m.	August 17	8 a.m.	12	20
August 19	8 p.m.	August 20	8 a.m.	12	25
			Totals	119	983

Table 5. Average catch per net set and fiducial intervals at the 95% confidence level, Inez, Alva and Rainy Lakes -- July 7-12, 1958.

Lake	No. Sets	Ct	Dv	KOK	Wf	CRC	SQ	FSu	CSu Col.	YP	PS	Rb
Inez	20	.2 (0.0-0.5)	0.6 (0.1-1.1)	0.1 (0.0-0.2)	14.4 (5.2-23.6)	0.2 (0.1-0.3)	4.4 (2.4-6.4)	1.4 (0.1-2.7)	3.1 (1.3-4.9)	7.0 (2.8-11.2)	0.1 (0.0-0.2)	0.1 (0.0-0.2)
Alva	20	0.6 (0.1-1.1)	1.5 (0.5-2.5)	0.1 (0.0-0.2)	4.5 (1.9-7.1)	2.1 (0.6-3.6)	11.2 (4.4-18.0)	3.1 (1.6-4.5)	2.2 (0.5-3.9)	16.5 (13.5-19.5)	None	0.1 (0.0-0.2)
Rainy	10	0.2 (0.0-0.5)	None	None	6.8 (3.0-10.6)	3.9 (0.8-7.0)	11.3 (8.0-16.6)	6.3 (4.0-8.6)	1.0 (0.2-1.8)	9.5 (4.0-15.0)	None	None

Table 6. Average catch per net set and fiducial intervals at the 95% confidence level -- Inez, Alva and Rainy Lakes -- spring netting 1955, 1956, 1957 and 1958.

Lake	Year	Ct	Dv	Wf	YP	PS
Inez	1955	0.1 (0.0-0.3)	0.3 (0.0-0.6)	6.9 (3.9-9.9)	1.7 (0.2-3.2)	None
	1956	None	0.7 (0.4-1.0)	7.3 (4.0-10.6)	9.5 (3.2-15.8)	0.1 (0.0-0.3)
	1957	0.1 (0.0-0.1)	0.8 (0.4-1.2)	8.6 (6.1-11.1)	9.7 (1.7-17.7)	0.1 (0.0-0.1)
	1958	0.2 (0.0-0.5)	0.6 (0.1-1.1)	14.4 (5.2-23.6)	7.0 (2.8-11.2)	0.1 (0.0-0.2)
Alva	1955	0.4 (0.0-0.9)	0.6 (0.2-1.0)	2.8 (1.0-4.6)	0.3 (0.0-0.7)	None
	1956	0.1 (0.0-0.3)	0.9 (0.5-1.3)	5.0 (3.3-6.7)	1.6 (0.8-2.4)	None
	1957	0.6 (0.2-1.0)	1.4 (0.5-2.3)	6.0 (3.7-8.3)	1.4 (0.0-2.8)	None
	1958	0.6 (0.1-1.1)	1.5 (0.5-2.5)	4.5 (1.9-7.1)	16.5 (13.5-19.5)	None
Rainy	1955	0.6 (0.0-1.3)	0.9 (0.0-1.8)	9.3 (5.2-13.4)	0.9 (0.2-1.6)	None
	1956	0.5 (0.0-1.0)	1.2 (0.1-2.3)	10.6 (8.1-13.1)	5.6 (0.0-15.6)	None
	1957	0.8 (0.0-1.7)	1.4 (0.1-2.8)	16.4 (9.6-23.2)	2.1 (0.0-4.8)	None
	1958	0.2 (0.0-0.5)	None	6.8 (3.0-10.6)	9.5 (4.0-15.0)	None

Table 7. Average catch per net set and fiducial intervals at the 95% confidence level -- Inez, Alva and Rainy Lakes -- spring netting 1955, 1956, 1957 and 1958.

Lake	Year	SQ	CRC	FSu	CSu Col.
Inez	1955	6.0 (3.2-8.6)	0.9 (0.2-1.6)	2.9 (0.4-5.4)	0.4 (0.0-0.8)
	1956	4.2 (1.9-6.5)	1.4 (0.4-2.4)	1.2 (0.2-2.2)	2.5 (0.6-4.4)
	1957	7.8 (2.1-13.5)	1.3 (0.0-2.7)	1.1 (0.1-2.1)	9.7 (0.0-2.0)
	1958	4.4 (2.4-6.4)	0.2 (0.1-0.3)	1.4 (0.1-2.7)	3.1 (1.3-4.9)
Alva	1955	5.2 (3.0-7.4)	0.8 (0.1-1.5)	2.2 (1.1-3.3)	0.5 (0.1-0.5)
	1956	9.9 (4.7-15.1)	1.4 (0.4-2.4)	4.6 (2.7-6.5)	2.6 (0.3-4.9)
	1957	7.2 (2.7-11.7)	1.8 (0.3-3.3)	3.8 (2.2-5.4)	1.3 (0.3-2.3)
	1958	11.2 (4.4-18.0)	2.1 (0.6-3.6)	3.1 (1.6-4.5)	2.2 (0.5-3.9)
Rainy	1955	5.4 (2.4-8.4)	2.6 (0.4-4.8)	3.7 (1.3-6.1)	2.3 (0.4-4.2)
	1956	5.2 (1.6-8.8)	4.9 (0.0-10.1)	4.5 (1.6-7.4)	2.7 (0.7-4.7)
	1957	4.7 (2.4-7.0)	4.3 (0.8-7.8)	3.2 (0.0-6.9)	3.2 (0.4-6.0)
	1958	4.4 (2.4-6.4)	3.9 (0.8-7.0)	1.4 (0.1-2.7)	3.1 (1.3-4.9)

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HELENA, MONTANA

JOB COMPLETION REPORT
INVESTIGATIONS PROJECTS

State of Montana

Project No. F-12-R-4

Job No. IV

Period Covered May 1, 1957 to Oct. 30, 1957

Name Western Montana Fisheries Study

Title Cost Estimate Survey for the Rehabilitation of the Upper Clearwater Drainage

Abstract:

The Clearwater River sub-drainage, above Rainy Lake, was mapped and surveyed for a rehabilitation project. A barrier dam was designed for the outlet of Rainy Lake in order to prevent fish movement into this area. Stream flows and lengths, lake areas and volumes, and toxicant requirements are given. A procedure for the rehabilitation job is outlined. It is recommended that this sub-drainage be rehabilitated when the barrier dam is completed.

Objectives:

The objectives of this job were: to plan and make cost estimates for a fish barrier dam at the outlet of Rainy Lake; to prepare a development project for the construction of this dam; to obtain the data necessary for planning a rehabilitation project on the drainage above this barrier; and to make cost estimates of this rehabilitation project.

Techniques used:

The proposed damsite at the outlet of Rainy Lake was surveyed by the project leader, two engineers from the Soil Conservation Service and the ranger from the Seeley Lake District, Lolo National Forest, U.S.F.S. The Soil Conservation Service engineers designed the barrier, the U.S.F.S. reproduced the plans and issued a special use permit for the dam's construction. A Federal Aid in Fisheries Restoration, Development Project was prepared and submitted.

Large scale outline maps of the three lakes in this sub-drainage were pantographed from aerial photographs.

Soundings on Rainy and Summit Lakes were made with a Bendix Depth Recorder, which was installed on an outboard motor boat. Due to its inaccessibility, Clearwater Lake was sounded with a hand line, used from a raft. From the sounding data, thus collected, contour lines were drawn on the outline maps.

A polar planimeter was used to obtain the area enclosed by each contour line. The volume of water between each contour line was computed by the formula $V = (A_1 - A_2) \frac{1}{2} SD$; where V = volume, A_1 = area of one countour line, A_2 = area of next inner contour and SD = summation of the depths of the two contour intervals.

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Aerial survey disclosed no other bodies of water in this sub-drainage. Lengths of the stream sections, which must be rehabilitated, were measured with a map wheel, on ½ inch to the mile U.S.F.S. maps. Volumes of these streams sections were estimated at various points along their lengths.

Rainy and Summit Lakes were divided into sections and water volumes were computed by section for better boat distribution of the toxicant. Because Clearwater Lake will have to be treated by air, it was not sectioned.

Pro-Noxfish was chosen as the toxicant for Rainy and Clearwater Lakes and for the stream sections. This is the most economical of the rotenone emulsives and will break down rapidly enough to allow re-stocking the year following rehabilitation. It is planned to use Pro-Noxfish, Formula 56, for the lake water below 20 feet, in order to obtain better distribution of the toxicant in deep water.

Summit Lake is quite turbid, contains a heavy growth of submerged aquatics and is considered to be too shallow (Maximum depth 11 feet) to maintain a good trout fishery. Therefore, Fish-tox was selected for this body of water, in order to better insure a complete kill of rough species.

Areas immediately surrounding the three lakes were carefully examined, by ground survey, in order to locate any backwaters or pools, which were not apparent from the lake or from the air.

Toxicant requirements were computed at one part per million, toxicant to water. This was done by volume for Pro-Noxfish and by weight for Fish-tox.

Estimates were made of the labor, equipment, materials and supplies, and rentals necessary to rehabilitate this sub-drainage. A development project for this rehabilitation job has been prepared.

Findings:

An outline map of this area is shown on Figure 1.

The development project for the construction of the barrier dam was approved and the contract for construction was awarded to Gray Lumber Company, Seeley Lake, Montana. Construction of this barrier was started in November 1957.

Rainy and Clearwater Lakes, and the Clearwater River, were found to have no backwater areas, which would require special toxicant treatment. Summit Lake and Sucker Creek were found to contain numerous slow-flowing pools, backwaters and boggy areas. Beaver activity had deepened many of these and spread their water over larger areas. Most of this area is under a dense growth of willow and alder and had to be examined by careful ground survey. Because of its dense cover, it will have to be treated by ground crews equipped with back pumps.

Sucker Creek and the North Fork of the Clearwater River are included in the area to be treated, because they are below lakes where rough fish are known to exist. The South Fork of the Clearwater River was checked with Fish-tox about 500 yards upstream from its junction with the North Fork. About 15 pounds of Fish-tox removed the entire population of the stream, from its point of application to the river's mouth at Rainy Lake. All fish observed in this section were retrieved. These were: 274 mountain whitefish, 146 cutthroat trout, 65 dolly varden trout and three suckers. The suckers were taken within 100 yards of Rainy Lake; the other three species were taken throughout the entire stream section.

Bertha and Allen Creeks were found to go dry in late summer.

All the drainages flowing into Clearwater Lake were found to be dry, except for the spring. This had water for a distance of about 100 feet from the lake. It will have to be treated from the ground while the lake is being sprayed from the air.

The stream sections which must be included in the rehabilitation project are given in Table 1.

Table No. 1

STREAM SECTION	LENGTH	MAXIMUM AUTUMN FLOW
Sucker Creek	3 miles	Less than 1 cfs
N. Fork Clearwater River	3 miles	Less than 5 cfs
Clearwater River (from its forks to Rainy Lake)	1 mile	Less than 20 cfs
Spring above Clearwater Lake	100 feet	Less than 1 cfs

The following amounts of toxicant have been allowed for these areas: two hundred pounds of Fish-tox for the swamp area around Summit Lake, for Sucker Creek, and for the Clearwater Lake spring area; eighty pounds of Fish-tox for the North Fork of the Clearwater River; one-25 gallon drum of Pro-Noxfish for the one mile section of the Clearwater River.

Table 2 shows the areas and volumes of the lakes, the amounts and costs of the toxicants required for the various sections of the drainages.
It is estimated that the proper application of this toxicant will require 70 man-days, plus airplane hire for Clearwater Lake.

Recommendations:

The Clearwater sub-drainage, above the outlet to Rainy Lake, should be rehabilitated in the fall of 1958.

The following recommendations are made for the time sequence of the various phases of this rehabilitation project.

1. Apply Fish-tox to Summit Lake.

2. Treat Summit Lake bog areas, Sucker Creek and Sucker Creek backwaters with back pumps.

3. Buoy off 20 foot contour line in Clearwater Lake and mark off Rainy Lake Sections.

4. Apply Pro-Noxfish to Clearwater Lake by airplane and treat spring flow by ground crew.

5. Apply Fish-tox to the North Fork of the Clearwater River.

6. Install dripper barrel in the Clearwater River just above junction of the forks. Keep in operation until Rainy Lake is treated.

7. Apply Pro-Noxfish to Rainy Lake by boat.

Table No. 2. Amount and cost of toxicants for the various portions of the Upper Clearwater Drainage.

LAKE (or section)	AREA	ACRE FEET	GALLONS (or pounds)	COST
Clearwater	127 acres	1774 (above 20' contour)	660 gal. Pro-Noxfish	$2692.80
		1017 (below 20' contour)	385 gal. Pro-Noxfish "56"	1651.50
Rainy Lake	69 acres	1054 (above 20' contour)	385 gal. Pro-Noxfish	1570.80
		134 (below 20' contour)	55 gal. Pro-Noxfish "56"	235.95
Summit Lake	26 acres	136	400 lbs. Fish-tox	148.00
Clearwater River			25 gal. Pro-Noxfish	102.00
North Fork Clearwater River			80 lbs. Fish-tox	29.60
Sucker Creek & Summit Lake backwaters			200 lbs. Fish-tox	74.00

Rainy and Clearwater Lakes should be planted in the spring of 1959 with one pound of rainbow trout (2 or 3 inch size) per surface acre. The Clearwater River should be replanted with the same amount of similar sized fish per mile of stream. These plants should continue for three years. Summit Lake should be checked for toxicity each year following treatment, and should be planted when it is no longer toxic.

Prepared by Arthur N. Whitney

Date December 9, 1957

Approved by George D. Holton

Date December 18, 1957

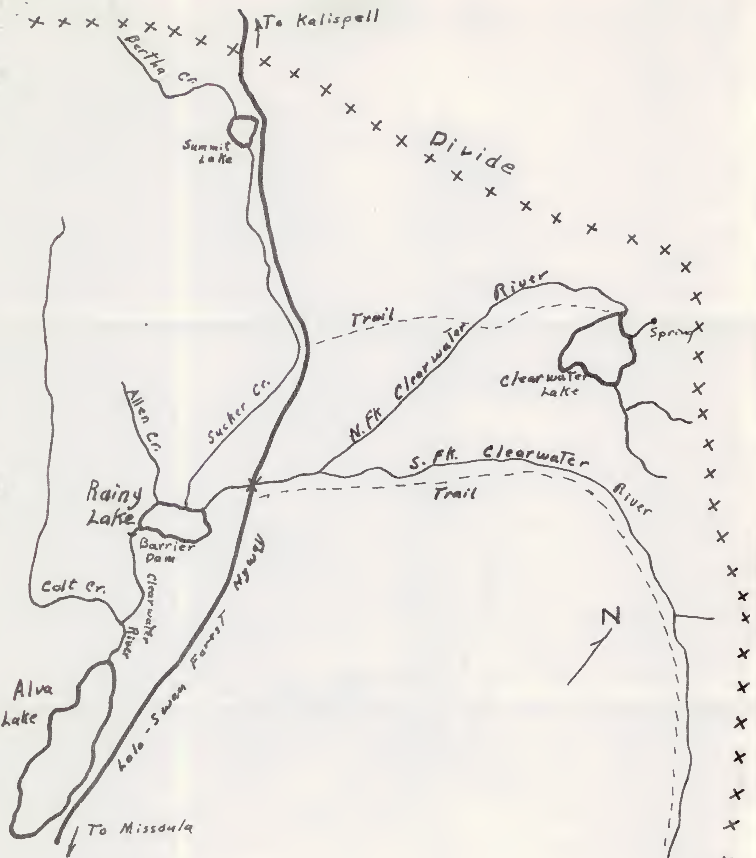

FIGURE NO. 1
UPPER CLEARWATER DRAINAGE

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III

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State of Montana

Project No. F-12-R-4 — Name Western Montana Fisheries Study

Job No. III — Title Cost Estimate Survey for Ninemile Prairie Rehabilitation Project

Period Covered: May 1, 1957 to November 30, 1957

Abstract: All major lakes and streams above the proposed Ninemile Prairie damsite have been mapped and surveyed for a rehabilitation project. Stream flows and lengths, lake areas and volumes, toxicant amounts, and a three-year trout re-stocking program are given. A recommendation is made for the construction of two fish barriers below the Clearwater Lakes. A complete cost estimate for rehabilitation, re-stocking, barrier construction and future survey work is presented.

Objectives: The objectives of this job were: to locate, map, sound and compute water volumes for all major lakes above the proposed Ninemile Prairie project; to compute water volumes, stream lengths, and upstream range of yellow perch, squawfish and Columbia River chub in the main stream drainages above the proposed project site; to locate portions of the drainage isolated by natural barriers, if any; to compute toxicant amounts, and rehabilitation costs for all waters above the proposed project site that contain populations of one or more of the above listed fish species; and to estimate the number of trout required to re-stock the area, along with the cost of this re-stocking.

Techniques Used: All major waters above the proposed Ninemile Prairie damsite were surveyed by the Project Leader, the Project Biologist, and two summer employees.

Large scale outline maps of the major lakes in the area were pantographed from aerial photographs. Soundings on all lakes were made with a Bendix Depth Recorder, mounted on an outboard motor boat. From the sounding data thus collected, contour lines were drawn on the outline maps.

A polar planimeter was used to obtain the area enclosed by

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each contour line. The volume of water between each contour line was computed by the formula: $V = (A_1 - A_2)\ \frac{1}{2}\ SD$; where V = volume, A_1 = area of one contour line, A_2 = area of next inner contour, and SD = summation of the depths of the two contour intervals.

An aerial survey of the area was made in an effort to locate other streams and lakes, that by their size and drainage characteristics, should be considered for rehabilitation. Lakes that appeared over 25 acres in size were photographed from the air, and an effort was made to survey these lakes from the ground.

The upstream ranges of yellow perch, squawfish and Columbia River chub, in the major stream drainages, was determined by blasting, angler reports, visual observation and electrical shocking. Due to its inaccessibility by road, the Clearwater River was surveyed from Rainy Lake to Seeley Lake by use of a rubber raft. A sketch map showing tributary stream locations, backwaters, and beaver dams was drawn.

Pro-Noxfish was chosen as the toxicant for the streams. Because of the excessive depths encountered, a special deep water toxicant, Pro-Noxfish formula 56 was chosen for the lakes. The above toxicants are the most economical of the rotenone emulsives and will break down rapidly, allowing the lakes to be re-stocked the following year. Toxicant requirements were computed by volume, at one part per million toxicant to water.

Estimates were made for the cost of rehabilitation, trout re-stocking and barrier construction for all water which have been surveyed and found to contain squawfish, yellow perch or Columbia River chub, above the proposed project site. Estimates were also made for: (1) the cost of surveying the remaining waters in the drainage, and (2) the cost of the toxicant which would be required if it should be found necessary to rehabilitate all the waters which are yet to be surveyed.

A trout re-stocking program was planned for a three year period, so that spawning fish will be evident before planting operations stop. Numbers of fish needed were based on the total surface acres for the lakes, and water volumes for the streams. The total re-stocking cost was based on numbers and sizes of fish to be planted.

Findings: An outline map of the area is shown in Figure 1.

The survey revealed that there are seven major lakes in the area that contain populations of yellow perch, squawfish,

Columbia River chub or combinations of the above fish species. Six of these lakes are on the main Clearwater River drainage, and one (Coopers) drains into the North Fork of the Blackfoot River.

Table 1 lists the above mentioned lakes along with their size, toxicant amounts, and toxicant cost for rehabilitation. Two barriers were found in the entire drainage. These were: a State Water Board dam on Nevada Creek, and a road culvert in the Bull Creek drainage. No squawfish, Columbia River chub, or yellow perch were found above the Nevada Creek dam. Yellow perch were found in the Bull Creek drainage, and that drainage was rehabilitated in the fall of 1957, under project F-24-D-9. Except for these two barriers, unrestricted fish movement is possible from one part of the drainage to another. The Clearwater River drainage, which contains six of the seven major lakes in the area, contains three possible barrier sites. One of these is below Rainy Lake, on the Clearwater River; one is below Salmon Lake, on the Clearwater River; and one is below Placid Lake, on Owl Creek. A barrier was constructed at the Rainy Lake outlet in the fall of 1957 (under project F-25-D-9) and the drainage portion above it will be rehabilitated in the fall of 1958.

The cost estimate for the construction of the other two barriers is listed in Table 6. By constructing these two barriers, the Clearwater River drainage could be rehabilitated by sections before the main Blackfoot drainage. A more thorough final rehabilitation job could be accomplished if these barriers are constructed, than could be done without them.

Table 2 lists the six main stream drainages above the proposed project site, along with the length, flow, toxicant amount and toxicant cost for each stream.

The upstream range of squawfish and Columbia River chub was found to be at the town of Lincoln, Montana for the Big Blackfoot River; Rainy Lake and Summit Lake for the Clearwater River; and the State Water Board dam on Nevada Creek. Owl Creek, outlet stream of Placid Lake, contains the above fish species along its entire length. The West Fork of the Clearwater River and the North Fork of the Blackfoot River do not contain the above fish species, at points five and ten miles respectively, upstream from their mouths.

Access points are not available along the entire length of any of the streams. However, the survey revealed that there are enough access points to insure adequate toxification of all waters. It will be necessary for personnel to walk along the streams after toxicant has been applied to observe its effect on fish life and to locate the next downstream point where toxicant should be applied.

In addition to the toxicant required for the major lakes and streams, another 15 drums (825 gallons) will be required for the smaller tributary streams flowing into the main drainages. The cost of this toxicant is included with the total toxicant cost. Table 6 gives the total cost of all toxicant, along with the cost of personnel and equipment needed to rehabilitate all major waters above the proposed Ninemile Prairie damsite.

Rainbow trout were chosen as the fish species to be used for re-stocking the rehabilitated waters. Re-stocking data for all lakes and streams previously mentioned is given in Tables 3 and 4. These tables list the re-stocking needs over a three year period. By stocking for three years, the initial plant will have reached sexual maturity during the same year the last plant is liberated. The plant for the lakes is given as 500 two inch fish per surface acre for the initial plant, and 50 four inch fish per surface acre for the second and third years. The planting of larger fish during the second and third year is recommended so that predation by the initial plant upon subsequent plants will be at a minimum. It is felt that fish growth in the streams will be slower than in the lakes. Thus, re-stocking in the streams is based on two inch fish for the initial and second year plants, and four inch fish for the third year plant.

The total number of fish to be planted in the streams is based upon water volume and stream miles per stream or stream section. Table 5 lists all the streams and/or stream sections along with the amount of fish to be planted per stream mile. The total cost of re-stocking the rehabilitated waters with trout is given in Table 6.

There are a minimum of 15 lakes in the area, of which aerial photographs have been taken, and which should be surveyed to determine the present fish species. Additional time also needs to be spent on some of the smaller stream tributaries to determine their importance in the overall rehabilitation program. Althought these unsurveyed lakes and streams are numerous, they are small in size. It is apparent, from our survey information to date and from a gross aerial observation of the area, that all together these unsurveyed waters comprise less than ten percent of the total water volume in this drainage. Therefore, an additional ten percent of toxicant was allowed in the estimate on Table 6. Thus, even if it is found necessary to rehabilitate all of these waters, the total project cost will not have to be increased.

Table 6 lists the total cost breakdown for rehabilitation, fish re-stocking, barrier construction and future survey work. The total cost of the entire operation is estimated at $1,125,000.00. A contingency fund of 9.6 percent is included in this figure.

Recommendations:

In the event Ninemile Prairie Dam is constructed, the following recommendations are presented:

1. All waters above the proposed damsite, that contain populations of yellow perch, squawfish, Columbia River chub or combinations of these species, should be rehabilitated.

2. In order to insure a successful, closely timed, rehabilitation program on all major streams above the proposed damsite, fish barriers should be constructed on the Clearwater River below Salmon Lake and on Owl Creek, below Placid Lake. After construction of these barriers, the Clearwater drainage above the Salmon Lake barrier, should be rehabilitated before the main Blackfoot drainage.

3. All lakes and streams listed on Tables 1 and 2 should be re-stocked with rainbow trout over a three year period, after rehabilitation. Recommended re-stocking rates are given in Tables 3 and 4.

Additional survey work must be carried on to determine if any of the numerous smaller waters in the area contain populations of yellow perch, squawfish, or Columbia River chub. Any waters, wherein these species are located, must be included in the overall rehabilitation program. Additional survey work is also required, in order to draw up the final operation plan for this rehabilitation project.

5. The cost of rehabilitating and re-stocking all the waters under consideration in this report would be prohibitive for the State Fish and Game Department. It is recommended that all cost relating to rehabilitation, fish planting, barrier constructing and future survey work be borne by the agency constructing Ninemile Prairie Dam.

Prepared by Robert C. Averett & Arthur N. Whitney   Approved by George D. Holton

Date April 14, 1958

TABLE NO. I

Toxicant Amounts and Cost for Major Lakes Above Ninemile Prairie

Lake	Surface Acres	Acre Feet	Gallons	Cost
Salmon	613	19,480	7,029	$30,154.41
Seeley	863	51,763	18,675	80,115.75
Placid	1,110	58,076	20,954	89,892.66
Inez	286	10,628	3,835	16,452.15
Alva	292	14,782	5,333	22,878.57
Millpond	16	320	114	489.06
Coopers	182	7,364	2,657	11,398.53

TABLE NO. 2

Toxicant Amounts and Cost for Major Streams Above Ninemile Prairie

Stream	Miles of Stream to be Toxified	Expected Autumn Flow (cfs)	Gallons	Cost
Nevada Creek	20	20	110	$ 448.80
Clearwater River	25	200	242	987.36
Big Blackfoot River	70	500	2,200	8,976.00
West Fork Clearwater River	5	20	110	448.80
Owl Creek	4	15	60.5	246.84
North Fork Blackfoot River	10	200	242	987.36

TABLE NO. 3

Planting Rates for Major Lakes and Reservoir

Lake	Surface Acres	Initial Plant @ 500 fish/acre (2 inch fish)	Initial Plant Cost	2nd Year Plant @ 50 fish/acre (4 inch fish)	2nd Year Plant Cost	3rd Year Plant @ 50 fish/acre (4 inch fish)	3rd Year Plant Cost
Salmon	613	306,500	$3,678.00	30,650	$3,678.00	30,650	$3,678.00
Seeley	863	431,500	5,178.00	43,150	5,178.00	43,150	5,178.00
Placid	1,110	555,000	6,660.00	55,500	6,660.00	55,500	6,660.00
Inez	286	143,000	1,716.00	14,300	1,716.00	14,300	1,716.00
Alva	292	146,000	1,752.00	14,600	1,752.00	14,600	1,752.00
Millpond	16	8,000	96.00	800	96.00	800	96.00
Coopers	182	91,000	1,092.00	9,100	1,092.00	9,100	1,092.00
Ninemile Prairie Reservoir	12,000	6,000,000	75,000.00	600,000	75,000.00	600,000	75,000.00

TABLE NO. 4

Planting Rates for Major Streams Above Ninemile Prairie

Stream	Miles	Initial Plant (2 inch fish)	Cost Initial Plant	2nd Year Plant (2 inch fish)	Cost 2nd Year Plant	3rd Year Plant (4 inch fish)	Cost 3rd Year Plant
Nevada Creek	20	40,000	$ 480.00	40,000	$ 480.00	4,000	$ 480.00
W. Fork Clearwater River	5	10,000	120.00	10,000	120.00	1,000	120.00
N. Fork Blackfoot River	10	75,000	900.00	75,000	900.00	7,500	900.00
Owl Creek	4	8,000	96.00	8,000	96.00	800	96.00
Clearwater River	25	130,000	1,560.00	130,000	1,560.00	13,000	1,560.00
Big Blackfoot River	100	870,000	10,440.00	870,000	10,440.00	87,000	10,440.00

TABLE NO. 5

Planting Rates for Stream Sections Above Ninemile Prairie

Stream	Section Location	Stream Miles	FISH PER STREAM MILE Initial Plant (2 inch fish)	Second Year (2 inch fish)	Third Year (4 inch fish)
Nevada Creek	From mouth to State Water Board dam	20	2,000	2,000	200
Clearwater River	Mouth to Salmon Lake	8	7,500	7,500	750
	Salmon Lake to confluence with West Fork Clearwater River	12	5,000	5,000	500
	Confluence West Fork to Rainy Lake	5	2,000	2,000	200
Big Blackfoot River	Mouth to confluence with Clearwater River	30	15,000	15,000	1,500
	Confluence with Clearwater to confluence with North Fork Blackfoot River	18	10,000	10,000	1,000
	Confluence with North Fork to confluence with Nevada Creek	12	7,500	7,500	750
	Confluence Nevada Creek to Lincoln, Montana	30	5,000	5,000	500
W. Fork Clearwater River	From mouth to confluence with Marshall Creek	5	2,000	2,000	200
Owl Creek	Mouth upstream to Placid Lake	4	2,000	2,000	200
N. Fork Blackfoot River	Mouth to Spring Creek	10	7,500	7,500	750

TABLE NO. 6

Total estimated cost for rehabilitation, re-stocking and barrier construction for all waters above the proposed Ninemile Prairie Dam Project

Rehabilitation	
Toxicant	
Waters Surveyed - - - - - - - - - - - - -	$ 266,842.29
Waters Not Surveyed - - - - - - - - - - -	26,684.22
Personnel	
Salary and Wages - - - - - - - - - - - -	36,960.00
Subsistence - - - - - - - - - - - - - -	7,560.00
Equipment	
Vehicle Mileage - - - - - - - - - - - -	19,870.00
Rentals - - - - - - - - - - - - - - - -	12,000.00
Rehabilitation Equipment - - - - - - -	20,000.00
Fish Re-stocking - - - - - - - - - - - - - - - -	326,304.00
Miscellaneous Expenditures	
Barriers - - - - - - - - - - - - - - - - - -	300,000.00
Future Survey Work - - - - - - - - - - - - -	10,000.00
Cost of Work Summarized Above - - - - - - - - -	1,026,220.51
Contingency Fund 9.6% - - - - - - - - - - - - - -	98,779.49
Total Estimated Cost - - - - - - - - - - - - - -	1,125,000.00

Figure 1. Outline Map Showing Main Drainages Above Proposed Ninemile Prairie Dam.

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JOB COMPLETION REPORT

INVESTIGATIONS PROJECTS

State of Montana

Project No.: F-12-R-4 Name: Western Montana Fisheries Study

Job No.: II Name: Biology of the Columbia Squawfish and Columbia River Chub

Period Covered: May 1, 1957 - April 30, 1958

Abstract: See attached manuscript.

Objectives: " " "

Techniques used: " " "

Findings: " " "

Recommendations:

Because of the similarity of the habitat requirements and food habits of these fish with those of desirable game fish, i.e., trout, it is reasonable to assume that removal of these fish from a body of water would result in higher populations and production of game species.

Projects aimed at removal of rough fish by trapping, netting, etc., have almost invariably failed to accomplish the results for which they were inaugurated. The only presently known method of eliminating or substantially controlling undesirable species is by poisoning and restocking with desirable fish. It is recommended that these species be removed by this method where fishing pressure is of sufficient magnitude and where conditions are favorable (economically reasonable volume of water to be treated, presence of suitable barriers or sites for barriers, etc.).

In view of the cost of such rehabilitation projects, it is recommended

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that a complete kill of these species be striven for. Under certain circumstances, a nearly complete removal of these species may be justified, since this could be expected to provide a desirable fishery for several years. These species, particularly the Columbia squawfish, require a considerable number of years to attain sexual maturity. The time required for them to regain their population levels may be long enough to justify rehabilitation with an incomplete kill. However, it is reasonable to expect that a sharp lowering of population levels would reduce the age at which sexual maturity is reached. Since several unknown quantities are involved in such a course of action, rehabilitation without reasonable assurance of a complete kill and subsequent control of immigration should be entered into with caution.

Prepared by: Cliff W. Hill Approved by: ____________________

Date: ____________________

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Abstract

The life histories of the Columbia River chub and the Columbia squawfish were studied during the summers of 1956 and 1957 in the drainage of the Big Blackfoot River, Montana. Both species occurred in certain lakes of the drainage, in the lower portion of the Big Blackfoot River and in one principal tributary. The Columbia squawfish also occurred in the upper portion of the Big Blackfoot River. Both species inhabited shallow, vegetated areas in lakes. Columbia squawfish were found in areas of relatively calm water in streams. The growth of Columbia River chub was studied by examining the scales from 300 fish. Specimens of this species up to nine years of age were collected. Growth of Columbia squawfish was based on examination of scales from 339 fish. Some individuals of this species attained an age of at least 15 years. Columbia River chub matured sexually at three to five years of age while Columbia squawfish matured at six to eight. Both species spawned in late May and early June while average water temperatures were 55-65° F. The stomach contents of 42 Columbia River chub and 83 Columbia squawfish were examined. Insects were the predominant item in the stomachs of both species. Fish were found in some Columbia squawfish stomachs.

Introduction

The Columbia River chub (Mylocheilus caurinus) and the Columbia squawfish (Ptychocheilus oregonense) are abundant native fishes in the Columbia River drainage of western United States. Both grow to the size of many game fish but are little utilized as food and are generally classified as rough fish. They may compete with trout and salmon for food and space. In one area the Columbia squawfish was found to be an important predator on young sockeye salmon (Ricker, 1941; Foerster and Ricker, 1941). Both take bait readily and are considered a nuisance by anglers.

Until recently, little work was done on these fishes. In view of their abundance and widespread distribution in western Montana, a study of their habits and life histories was undertaken as a part of the fisheries management program for the area. The drainage of the Big Blackfoot River was selected for the present investigation, which was carried out during the summers of 1956 and 1957.

The Big Blackfoot River and its tributaries drain portions of Lewis and Clark, Powell and Missoula counties in Montana. This drainage includes about 2,100 square miles and is bounded on the east and northeast by the Lewis Range, on the north and west by the Swan and Mission ranges and on the south by the Garnet Range. The highest point in the drainage is about 9,000 feet. The elevation of the Big Blackfoot River at its confluence with the Clark Fork, Columbia River is 3,300 feet. Most of the area is characterized by sharp relief and is vegetated by coniferous

forests. The average gradient of the Big Blackfoot River and its principal tributaries is approximately 11 feet per mile.

The Clearwater River is the largest tributary of the Big Blackfoot River. It occupies a narrow wooded valley 32 miles long lying north of the principal drainage. This river flows through eight lakes which make up a large part of the habitat suitable for the Columbia River chub and the Columbia squawfish. These lakes range from 25 to 1,200 acres in surface area. They are generally characterized by having abrupt shorelines and extensive depths (90 to 100 feet). The sharply inclined shoal areas have bottoms of gravel and rubble and those with gradual slopes have bottoms of sand or silt, sometimes covered with considerable debris and limited areas of vascular vegetation.

The water of the drainage is moderately soft (total alkalinity: 12 to 20 p.p.m.). The deeper lakes stratify thermally and chemically in summer but oxygen depletion is not severe.

The two minnows under consideration are among the most abundant fishes of the drainage. Other native fish present are: Redside shiner (<u>Gila balteata</u>), Longnose dace (<u>Rhinichthys cataractae</u>), Longnose sucker (<u>Catostomus catostomus</u>), Columbia large-scaled sucker (<u>C. macrocheilus</u>), Cutthroat trout (<u>Salmo clarki</u>), Dolly Varden (<u>Salvelinus malma</u>), Mountain whitefish (<u>Coregonus williamsoni</u>), Rocky Mountain sculpin (<u>Cottus bairdi punctulatus</u>). Introduced species include: Rainbow trout (<u>Salmo gairdneri</u>), Brown trout (<u>S. trutta</u>), Kokanee (<u>Oncorhynchus nerka kennerlyi</u>), Eastern Brook trout (<u>Salvelinus fontinalis</u>), Yellow perch

(Perca flavescens), Largemouth black bass (Micropterus salmoides), Pumpkinseed (Lepomis gibbosus). Three specimens indentified as hybrids between Columbia squawfish and Columbia River chub were collected during the study. Hybrids between these species were previously reported in Montana by Weisel (1953).

The writer wishes to thank Dr. C. J. D. Brown and Richard J. Graham, who directed the study and assisted in the preparation of the manuscript; Arthur N. Whitney, who suggested the problem and gave valuable help; other personnel of the Montana Fish and Game Department for assistance in the field; and my wife, Gail, for field assistance and encouragement. The Montana Fish and Game Department financed the field investigation under Federal Aid to Fisheries Restoration Project F-12-R. The writer was a graduate fellow of the National Science Foundation for a part of the period involved in the study.

Distribution and Habitat

Distribution. The distribution of the Columbia River chub and the Columbia squawfish within the Big Blackfoot River drainage was determined from collections made during the present study and from collections made by the Montana Fish and Game Department in 1954 (Fig. 1). The following sampling methods were used: lakes - gill netting; the Big Blackfoot River - dynamiting; the Clearwater River below Salmon Lake - angling; the Clearwater River above Rainy Lake - poisoning with rotenone; all other stream stations - electrical shocking. A number of small streams tributary to the Big Blackfoot River were sampled without collecting

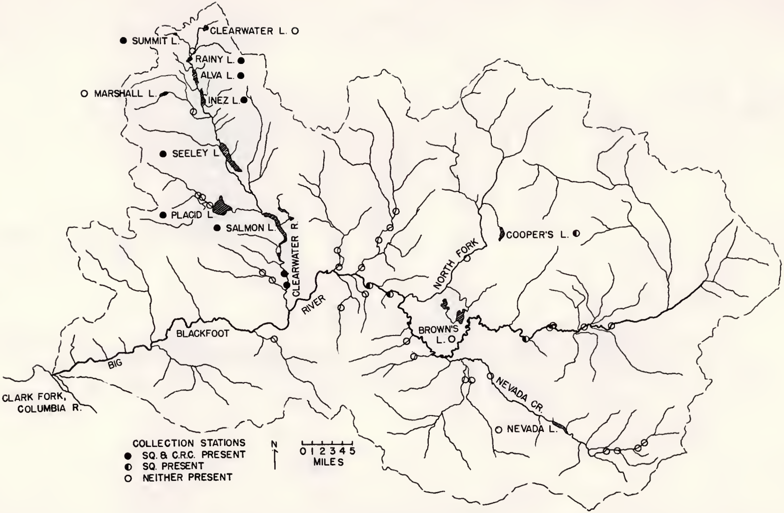

Figure 1. Map of the Big Blackfoot River drainage, showing collection stations and occurrence of the Columbia River chub and Columbia squawfish.

either species. Other small streams with steep gradients were not sampled. No recent collections were made on the Big Blackfoot River below the mouth of the Clearwater River, although records from 1948 are available for this area. Recent creel census records also show that both Columbia River chub and Columbia squawfish are present there.

The Columbia River chub was found to be abundant in certain lakes of the Clearwater River drainage. They occurred in small numbers in the broad, slow areas of the Clearwater River below Salmon Lake and in the Big Blackfoot River below the mouth of the Clearwater River.

Columbia squawfish were present in the same lakes of the Clearwater River drainage. This species was also present in Cooper's Lake, which has an outlet intermittently flowing into the North Fork, Big Blackfoot River. It was not found in this latter river. The fish from Cooper's Lake were more darkly pigmented than those found in the Clearwater drainage and in the Big Blackfoot River. Columbia squawfish were common in the lower Clearwater River and in the Big Blackfoot River below the mouth of the Clearwater River. They were also found in the Big Blackfoot River upstream to a point about two miles above the mouth of Arrastra Creek. Collections made at stations in the upper portion of this river contained only large fish (those above Arrastra Creek were 11.3 - 15.7 inches in length*). Searches for young of the year at several stations on the Big Blackfoot River disclosed none more than 15 miles upstream from the mouth

* All length measurements used in this report are total lengths; maximum length from tip of snout to the longest part of the caudal fin.

of the Clearwater River. Evidently little or no successful reproduction occurred in the upper portion of the range of this species.

Habitat. In lakes, both Columbia River chub and Columbia squawfish were found to occur almost exclusively in the shallow areas during summer. Few fish were captured in nets set at depths greater than 20 feet. Both species inhabited areas where submerged vegetation was present, except during the spawning period. At that time fish were captured in open areas as well as in vegetated areas. In Seeley Lake during late March, 1957, when ice cover was present, fish of both species were captured in gill nets set in vegetation at depths of eight feet or less but not at greater depths. These fish quite possibly remained in shallow vegetated areas during the period of ice cover.

Young of the year Columbia River chub and Columbia squawfish captured in lakes before July 8, 1957 were found in water less than one foot deep along rubble or gravel shores. After August 1, these fish were found in nearby areas of submerged vegetation at depths less than three feet.

Columbia squawfish in the Big Blackfoot River were captured in large pools (8-12 feet deep and up to 100 feet long). In the Clearwater River they were taken in pools and in other areas of low gradient. Groups of fish less than six inches in length were also observed in riffle areas of the latter river, where they were concentrated in the shelter of the boulders along the river's edge. Young of the year were found in protected places near shore and in backwaters of the Big Blackfoot River and the Clearwater River.

Growth

Methods. Young-of-the-year fish were collected with a dip net until mid-August, but at that time the fish were able to evade this net. A seine was used for subsequent collections in lakes.

The growth of older fish in certain lakes was determined by examining scales from fish captured in gill nets. The nets used were 125 feet long with 25 foot sections of 3/4, 1, $1\frac{1}{4}$, $1\frac{1}{2}$ and 2 inch square mesh. The largest mesh was of a size capable of capturing fish larger than any encountered during the study. Some young age groups were not vulnerable to the nets and were not collected. Scales were taken from each fish in the area between the base of the dorsal fin and the lateral line. Measurements of scale radii were made with the aid of a scale projector. Total lengths at formation of annuli were calculated with a nomograph. A linear relationship between scale radius and body length was assumed.

A length-frequency distribution was also used for evaluating the growth of Columbia squawfish in the Clearwater River. Fish used were captured by seining and angling.

Columbia River chub. Young-of-the-year Columbia River chub from Placid Lake attained an average length of 2.2 inches by September 12, 1957 (Table I).

Scales of 300 fish collected during 1956 were used for determining the growth of Columbia River chub in Placid Lake. Collection periods were mid-June and late August and early September. The youngest fish in the sample were two years old. Age class II was not represented in the June collections but had attained a size vulnerable to the 3/4 inch gill

Table I. Growth of young-of-the-year Columbia River chub and Columbia squawfish in Placid Lake, 1957.

Date	Columbia River chub			Columbia squawfish		
	Length, inches			Length, inches		
	Av.	Range	No.	Av.	Range	No.
Aug. 6	1.2	1.1-1.3	15	1.4	1.3-1.5	12
Aug. 16	1.5	1.4-1.7	7	1.7	1.6-1.7	5
Sept. 12	2.2	2.0-2.4	30	2.1	1.6-2.4	15

net mesh by late August. Scales from young-of-the-year fish were examined in order to evaluate growth in the first summer and to aid in locating the first annulus. The scales of young fish (2.0-2.2 inches in length) collected in September had 9-12 circuli.

The average size of female Columbia River chub was greater than that of males. This resulted from greater longevity and from a slightly faster growth rate in females (Table II). The average calculated length of females was 0.2 inches greater than males at five years and 0.7 inches greater at seven years, the oldest group in which males were represented. The oldest female in the sample (13.5 inches in length) was aged at nine years. Several males (10.4-11.1 inches in length) were aged at seven years.

Columbia squawfish. Young-of-the-year of this species from Placid Lake attained an average length of 2.1 inches by September 12, 1957 (Table I). Columbia squawfish collected in the Clearwater River below Salmon Lake were considerably smaller than those taken from Placid Lake at comparable times. On August 3, 1957, fifteen fish averaged 0.9 inches in length (range: 0.8-1.0) and on August 21, eight fish averaged 1.2

Table II. Calculated growth of Columbia River chub in Placid Lake.

Age Class	Sample size I*	M	F	T	Average length at annulus formation 1	2	3	4	5	6	7	8	9
II	6			6	2.4	4.6							
III	76	18		94	2.6	4.8	7.0						
IV	10	8	6	24	2.7	4.8	6.9	8.6					
V	1	41	9	51	2.7	4.7	6.7	8.5	9.8				
VI		23	31	54	2.6	4.5	6.5	8.3	9.6	10.7			
VII		6	53	59	2.6	4.4	6.4	8.1	9.5	10.5	11.4		
VIII			11	11	2.7	4.5	6.4	8.3	9.8	10.9	11.7	12.6	
IX			1	1	3.1	4.5	6.7	8.7	9.8	11.3	12.0	12.7	13.5
Average	93	96	111	300	2.6	4.6	6.7	8.3	9.6	10.6	11.5	12.6	13.5

* I: immature; M: male; F: female; T: total.

inches in length (range 1.1-1.5). Growth of young in the Big Blackfoot River was similar to that in the Clearwater River.

A length-frequency distribution was made from 127 Columbia squawfish collected in the Clearwater River below Salmon Lake (Fig. 2). Fish 1.9-4.3 inches in length were collected by seining on July 17, 1956 and fish

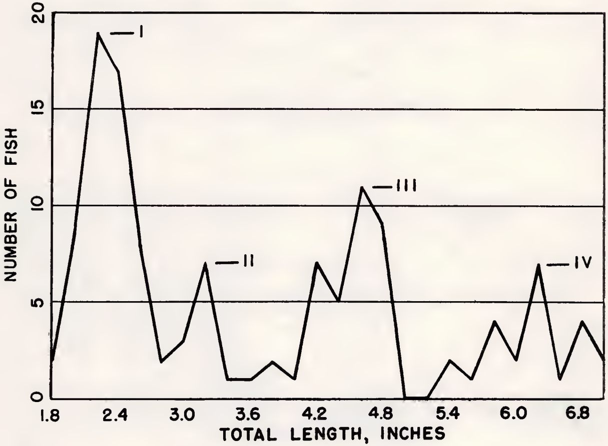

Figure 2. Length-frequency distribution of 127 Columbia squawfish collected in the Clearwater River, July 17 and 27 and August 3, 1956.

4.2-11.3 inches in length were collected by angling on July 27 and August 3, 1956. The length-frequency distribution of these combined samples ex-

hibited modes at 2.4, 3.3, 4.6 and 6.1 inches. Modes at greater lengths were not evident. An examination of the scales of these fish indicated that the above modes represented age classes I through IV. The comparative weakness of the mode at 3.3 inches was due to the low vulnerability of this size group to both collection methods used.

Information on growth of Columbia squawfish in Alva Lake was obtained from scales of 267 specimens collected during the summers of 1956 and 1957 (Table III). Age classes IV through XV were represented in this sample. Since no smaller fish from Alva Lake were available, younger fish from the Clearwater River and from Placid Lake were used to aid in evaluating growth in the first few years of life. Young-of-the-year Columbia squawfish collected in Placid Lake in September (2.0 inches in length) had 9-12 circuli.

Females grew slightly faster and attained a greater age than males. The difference in growth, noted in all age classes in the Alva Lake sample, was 0.7 inches at formation of the ninth annulus. The oldest males in the sample (13.0 and 13.2 inches long) were aged at 11 years. One female 18.3 inches long was aged at 15 years. Several other females up to 22.3 inches in length were collected, but they could not be aged with any degree of confidence and are not included in the growth data.

The growth of Columbia squawfish in Seeley Lake, based on an examination of the scales of 72 fish, was slightly greater than in Alva Lake. Age classes VI through XV were represented in this sample. Average calculated lengths at annulus (A) formation (sexes and age classes combined) were: A1 - 2.2; A2 - 3.5; A3 - 5.0; A4 - 6.5; A5 - 7.9; A6 - 9.2; A7 -

Table III. Calculated growth of Columbia squawfish in Alva Lake.

Age Class	Sample size I*	M	F	T	Average length at annulus formation 1	2	3	4	5	6	7	8	9	10	11	12
IV	4			4	2.0	3.6	5.1	6.5								
V	30			30	1.9	3.0	4.4	5.7	7.1							
VI	52	1		53	2.0	3.2	4.5	5.8	7.2	8.3						
VII	54	8	5	67	2.1	3.3	4.6	6.0	7.2	8.4	9.5					
VIII	26	9	5	40	2.2	3.5	4.7	6.0	7.2	8.3	9.5	10.5				
IX	3	21	11	35	2.2	3.4	4.7	6.1	7.5	8.7	9.8	10.9	11.8			
X		14	8	22	2.1	3.3	4.7	6.0	7.1	8.2	9.2	10.2	11.2	12.1		
XI		2	5	7	2.4	3.4	4.7	5.8	7.2	8.3	9.4	10.4	11.5	12.5	13.4	
XII**			9	9	2.1	3.3	4.5	5.7	7.0	8.3	9.4	10.5	11.5	12.5	13.5	14.4
Average	169	55	43	267	2.1	3.3	4.6	5.9	7.2	8.4	9.5	10.5	11.5	12.3	13.4	14.4

* I: immature; M: male; F: female; T: total.

** includes fish 12 years and older.

10.3; A8 - 11.4; A9 - 12.6; A10 - 13.9; A11 - 14.8; A12 - 15.9. One female, 17.4 inches in length, was aged at 15 years. Others up to 19.5 inches in length could not be aged with any degree of certainty.

Reproduction

Fecundity. Fish of both species were collected on March 25-27, 1957 in Seeley Lake for the purpose of estimating egg numbers. About two months in advance of the spawning seasons, this was a favorable time for collecting ovaries since eggs were large enough for accurate enumeration, yet there was no danger of loss during capture. Ovaries were removed from the fish and preserved in formalin. After removal of adhering fatty tissue, total volume of the ovaries was determined by displacement in water. The ovaries were than broken up and two or three samples, representing 5-10 percent of the total volume, were selected at random. The eggs contained in these samples were counted. Volumes of the samples were determined by displacement and an estimate of the total number of eggs was calculated.

Estimated egg numbers for seven Columbia River chub (11.8-12.8 inches in length) ranged from 11,800 to 18,900 (Table IV). Estimated egg numbers for seven Columbia squawfish (11.3-13.8 inches in length) showed much greater variation between individuals than Columbia River chub. Two fish, 12.1 and 12.3 inches long, contained 27,500 and 6,700 eggs, respectively. No relationship between fish size and number of eggs was noted in either species within the size ranges of the samples.

Age at sexual maturity. The sample discussed previously (see

Table IV. Estimated numbers of eggs contained in the ovaries of fish collected in Seeley Lake, March 25, 26 and 27, 1957.

Species	Total length, inches	Weight pounds	Number of eggs
Columbia River chub	11.8		11,800
" " "	11.9	0.66	16,400
" " "	12.1	0.70	18,900
" " "	12.3	0.73	15,200
" " "	12.4	0.69	16,400
" " "	12.6	0.83	16,800
" " "	12.8	0.76	15,400
Columbia squawfish	11.3	0.46	18,200
" "	11.4	0.48	9,800
" "	11.5	0.48	19,200
" "	12.1	0.51	27,500
" "	12.2	--	20,700
" "	12.3	0.54	6,700
" "	13.8	0.78	20,000

"Growth", p. 10) indicates that Columbia River chub in Placid Lake matured at three to five years of age. Mature males made up about 20 percent (18 of 94) of age class III. Mature females were well represented in age class IV, the first age class in which they were found. Only one of fifty-one fish in age class V was immature. The average calculated length at annulus formation of the mature three year old males was 6.5 inches; that of the mature four year old females was 8.4 inches.

Columbia squawfish collected in Alva Lake matured later in life than Columbia River chub in Placid Lake. Attainment of maturity by these Columbia squawfish also extended over a longer period of years. The youngest mature male in the sample was six years of age and the youngest mature female was seven. Immature fish made up the majority (26 of 40) of age class VIII and were present in small numbers (3 of 35) in age class IX. Average calculated lengths at annulus formation of mature seven year old males was 9.9 inches, that of females was 10.0 inches.

Spawning season. Gonad condition was recorded for adult fish of both species collected in Placid Lake between May 28 and July 6, 1957 and in Seeley Lake between June 3 and July 4, 1957. Females were classed as: full (including 'ripe' and 'green' individuals) or spent. These two conditions were readily recognized; the former is characterized by large ovaries with distinct large eggs, and the latter by small, flaccid ovaries colored dark red by abundant vascular tissue and containing occasional large eggs. The distinction between green and ripe fish could not be readily established and these classes were combined. An additional ovary condition (discussed below), representing non-breeding fish, was common

among Columbia squawfish. Males were classed as: ripe - with large white testes from which sperm could be squeezed; or spent - with flaccid, red testes in which sperm was no longer apparent. All fish used in evaluating the spawning seasons were collected in gill nets, except the June 9 and 16 collections from Placid Lake, which were obtained with a box trap set at the outlet.

Maximum-minimum water temperatures were taken to the nearest degree F. at the outlets of the above lakes at intervals of 1-4 days from May 9 to July 1, 1957. The thermometers were suspended 1-2 feet below the surface of the water and were protected from direct sunlight. These temperatures were believed to be about the same as those in the shoal areas which the fish inhabited, although no comparisons were made. Water temperatures expressed in Figures 3 and 4 were determined by averaging the maximum and minimum readings for each three day period.

Spawning activity of Columbia River chub in Placid Lake was in progress when collections began on May 28, 1957. Thirty-nine percent (12 of 31) of the females captured on that day were spent. Of the females collected in nets set near the inlet, few (2 of 18) had spawned while most (10 of 13) females collected near the outlet had spawned. The inlet side of the lake is characterized by extensive shoal areas with sand and silt bottoms and abundant vascular vegetation while most of the shoal area within one mile of the outlet has a bare bottom of gravel or rubble. The latter is similar to that used in spawning by Columbia River chub in Washington Lake (Schultz, 1935). It is probable that those individuals which became ripe early had concentrated in the areas favorable for spawn-

ing. All males (108 individuals) collected in both areas on May 28 were ripe.

The number of spent females in the collections of May 29 through June 9 rose rather steadily from 50 to 94 percent (Fig. 3) except for the

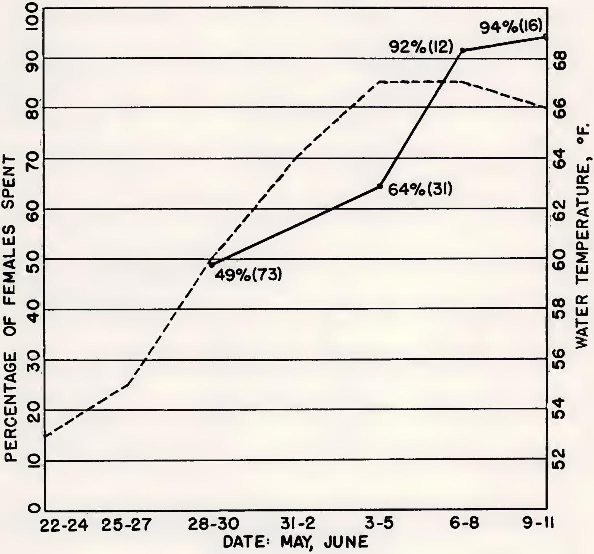

Figure 3. Gonad condition of female Columbia River chub collected in Placid Lake, 1957. Dotted line indicates average water temperature at outlet.

collection of June 5. All nets lifted on this latter date were set in soft bottomed areas with abundant vegetation. Some unspawned females were present in early July collections.

Average water temperatures at the outlet of Placid Lake rose rather steadily during the latter half of May and reached a maximum of 67° during the first week in June. Average water temperatures at the beginning of spawning activity by Columbia River chub (probably about May 24 or 25) was approximately 54°. Extremes of water temperatures during the peak of spawning activity were 52° on May 29 and 72° on June 3 and 4.

Spawning activity of Columbia squawfish in Seeley Lake occurred somewhat later than that of Columbia River chub in Placid Lake. Only 15 percent (3 of 20) of breeding females collected on June 3-5 had spawned (Fig. 4). The spawning season of Columbia squawfish was also less abrupt than that of the Columbia River chub. Forty-seven percent (8 of 15) of the breeding females collected on June 15 and 86 percent (24 of 28) of those collected on June 26 were spent.

Temperature conditions in Seeley Lake during the period prior to spawning were similar to those in Placid Lake. Average temperatures during the first two weeks in June did not reach the level of those in Placid Lake (Fig. 4). Average temperature at the beginning of spawning activity by Columbia squawfish (probably about June 1) was approximately 58°. The lowest water temperature during the period of spawning activity was 53° on June 6; the highest was 72° on June 4 and 6.

During both years of the study considerable numbers of female Columbia squawfish were found to have ovaries containing small grey eggs

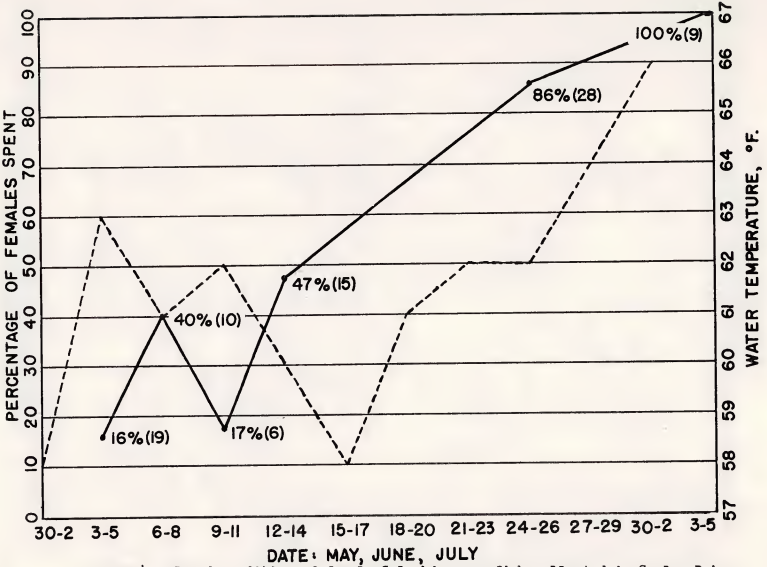

Figure 4. Gonad condition of female Columbia squawfish collected in Seeley Lake, 1957. Dotted line indicates average water temperatures at outlet.

which apparently would not have ripened during the breeding season of collection. These non-breeding fish were present in the collections of March, 1957 and in all collections throughout the summers of 1956 and 1957. They could be distinguished readily from the ripening fish of early collections as well as from the spent fish of late summer, whose ovaries contained very minute developing eggs of the next season. Twenty-five percent (29 of 117) of female Columbia squawfish collected in Seeley Lake during June, 1957 exhibited this ovary condition and were classed as non-breeding fish. Comparable numbers were found in other lakes of the Clearwater drainage. The fate of these eggs was not determined. Since they were found in a similar condition throughout the summer, it is unlikely that they were resorbed or that they represented late spawning fish. Probably they were retained in this green state over one or more years, perhaps to ripen during some subsequent spawning season. This ovary condition was not found in the Columbia River chub.

Although records of gonad condition in 1956 were limited, it was apparent that the spawning seasons of both species were about two weeks later than in 1957. Data from the weather station at Seeley Lake showed that temperature conditions in 1957 were about two weeks in advance of those in 1956.

Numerous attempts to observe spawning were made during the study but none was successful. A school of several hundred adult Columbia squawfish, believed to be a spawning group, was observed from 3 to 11 p.m. on June 18, 1957 in Cooper's Lake. The fish were concentrated within a few yards of shore over a rubble bottom. Occasionally one fish would dart toward

another, but most of the activity consisted of slow mass movement back and forth along the shore. No activity interpreted as actual spawning was noted. The fish did not appear to be disturbed by the light from a gasoline lantern suspended over the water, but dispersed gradually over a period of several hours. Jeppson (1957) reported that Columbia squawfish spawned over a rubble bottom at depths of two to twelve inches. Schultz (1935) described a similar spawning site selected by Columbia River chub.

None of the three Columbia squawfish x Columbia River chub hybrids collected during the study were sexually developed.

Food Habits

Methods. Stomachs from selected Columbia River chub and Columbia squawfish were preserved for study. Methods used in capturing fish used for stomach analysis were angling in streams and gill netting in lakes. Net sets of short duration (two hours or less) were employed, but since only a small number of fish was caught in the short daylight sets it was necessary to use the stomachs of some fish collected in overnight sets. Fish selected from the latter were those which appeared to have been in the nets a short time. Stomachs were preserved in 10 percent formalin, either after removal from the fish or in situ. The contents of each stomach were observed under magnification and the kinds of organisms present were noted. Visual estimates (to the nearest 10 percent) were made of the fraction each item contributed to the total.

Columbia River chub. Insects made up 51 percent of the stomach contents of 42 Columbia River chub (4.0-11.0 inches in length) taken between

August 6 and September 12, 1957 in Placid Lake and Rainy Lake (Table V). Adult ants (26 percent of the total) were the most abundant item. These insects were swarming in great numbers in the Clearwater drainage during August. Many of them fell on the surfaces of the lakes, resulting in extensive use by fish. Diptera larvae and mayfly nymphs were also present

Table V. Stomach contents of 42 Columbia River chub captured in Placid Lake and Rainy Lake, August and September, 1957.

Food organism	Average percentage of contents	Frequency of occurrence
Gastropoda	6	5
Pelycopoda	1	2
Cladocera	20	10
Hymenoptera	26	13
Diptera	5	12
Ephemeroptera	4	3
Coleoptera	2	1
Hemiptera	2	1
Odonata	1	1
Trichoptera	tr.*	1
Unidentified insects	11	14
Unidentified invert.	4	7
Debris	18	15
Plant material	tr.	1

* tr. means trace.

in moderate numbers. Nearly all of the mayfly nymphs were of one bottom dwelling species. Cladocerans constituted 20 percent of the stomach contents. These organisms were noticeably abundant in Placid Lake during late August and in Rainy Lake during early September. Snails made up six percent of the contents. Large amounts of sand were usually present in stomachs containing snails and Diptera larvae. Plant material occurred in

only one stomach.

Columbia squawfish. Insects made up 92 percent of the stomach contents of 32 Columbia squawfish (4.0-10.1 inches in length) collected in Placid Lake and Rainy Lake between August 8 and September 12, 1957 (Table VI). Adult ants were the most abundant item (23 percent of the total) and occurred in half of the stomachs. Water boatmen made up 20 percent of the contents. Adult damselflies and bottom dwelling forms (Diptera larvae and mayfly nymphs) also occurred in moderate numbers. Only one stomach contained the cladocerans which were abundant in the Columbia River chub stomachs. One stomach contained two small toads.

Table VI. Stomach contents of 32 Columbia squawfish captured in Placid Lake and Rainy Lake, August and September, 1957.

Food organism	Average percentage of contents	Frequency of occurrence
Hymenoptera	23	16
Hemiptera	20	9
Ephemeroptera	13	8
Odonata	10	6
Diptera	4	3
Coleoptera	2	4
Orthoptera	2	1
Unidentified insects	17	16
Cladocera	2	1
Unidentified invert.	tr.	1
Anura	2	1
Plant material	2	2
Debris	2	2

Fish remains were found in four of eight Columbia squawfish stomachs collected in Alva Lake on June 19, 1956. Each contained the remains of

8. The stomach contents of 42 Columbia River chub and 83 Columbia squawfish were examined. Insects were the predominant item in the stomachs of both species. Fish were found in some Columbia squawfish stomachs.

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MONTANA STATE DEPARTMENT OF FISH AND GAME
FEDERAL AID IN FISH RESTORATION SECTION
HELENA, MONTANA

JOB COMPLETION REPORT
INVESTIGATIONS PROJECTS

State of Montana

Project No. F-12-R-4 Name Western Montana Fishery Study

Job No. I Title Comparisons of Fish Populations of Six Clearwater Lakes

Period Covered: May 1, 1957 to April 30, 1958

Abstract: The six main Clearwater Lakes were netted simultaneously for the third season. Average catch per net set has been computed by species, for each season's sample from each lake. These average catch figures are compared by their fiducial limits at the 95% confidence level.

No significant changes in catch are indicated for cutthroat trout. It is recommended that the special cutthroat management measures which have been in use on these waters during the past three years be discontinued. A new management plan for the Clearwater drainage is given.

Objectives: The object of this job was to collect comparative netting data on the six Clearwater lakes for the third successive year. This data was collected for the purpose of evaluating different management measures used on these six lakes during the years 1955, 1956 and 1957.

Techniques Used: On June 2, six two-man crews assembled in the Seeley Lake area with netting equipment, and the first net sets were made before dark. Nets were lifted and reset on June 3, 4, 5, and 6 and were lifted and removed on June 7. Pertinent data on each set was recorded on Montana's standard netting forms. Each crew was furnished with a map of its respective lake, upon which the locations of the 1955 and 1956 net sets had been marked. In 1957, each individual net set was made at the location shown for that particular set in 1955 and 1956. In 1957, the crew for each lake was composed of at least one of the individuals who had worked on that same lake in either 1955 or 1956. All nets used were 125-foot, nylon, experimental gill nets. These nets consist of five equal sections of one and one-half, two, two and one-half, three and four inch, stretch measure mesh. The following number of nets were used in each lake: Salmon - 4, Seeley - 5, Placid - 5, Inez - 4, Alva - 4, and Rainy - 2.

The following daily schedule was used by all crews: Nets were lifted, all fish were worked, nets were mended when necessary and nets were reset. All fish captured were weighed, measured and recorded. Scale samples were taken from squawfish and Columbia River chub for use in the life history study of these species (Job No. II) and from trout, salmon and a few other species to fill in short or missing size groups in the previous years' collections.

During the week of July 28 - August 3; one, three-man crew repeated the netting on Inez and Rainy Lakes. This was done in order to ascertain if any cutthroat spawning run out of the lake during the spring netting, was affecting the catch ratios for this species.

Maximum-minimum thermometer stations were established at four points in the Clearwater Drainage. These were: (1) In the Clearwater River between lakes Alva and Inez. (2) In the Clearwater River at the outlet of Seeley Lake. (3) In Owl Creek at the outlet of Placid Lake. and (4) In the Clearwater River at the outlet of Salmon Lake. All stations were located under bridges, to eliminate the effect of direct sunlight on the instruments. Readings were recorded on May 9, and every second day following, through July 1.

Findings: Following is a list of abbreviations used on the tables in this report, common names and scientific names of the species of fish taken during the netting project:

Abbreviation	Common Name	Scientific Name
CT	Cutthroat trout	Salmo clarkii
EB	Eastern Brook trout	Salvelinus fontinalis
RB	Rainbow trout	Salmo gardnerii
DV	Dolly Varden trout	Salvelinus malma
LL	Brown trout	Salmo trutta
KOK	Kokanee	Oncorhynchus nerka
WF	Mountain whitefish	Prosopium williamsoni
SQ	Squawfish	Ptychocheilus oregonensis
CRC	Columbia River chub	Mylocheilus caurinus
FSu	Fine-scaled sucker	Catostomus catostomus
CSu	Coarse-scaled sucker	Catostomus macrocheilus
YP	Yellow perch	Perca flavescens
PS	Pumpkinseed sunfish	Lepomis gibbosus
RSh	Redside shiner	Richardsonius balteatus
LMB	Largemouth bass	Micropterus salmoides

The age and growth analysis has not been completed for the 1956 and 1957 additions to the 1955 collections. Therefore, age and growth data are not included in this report.

Total effort, by lakes, and total catch, by species, for the 1957 sampling are shown on Table 1. These same data for the 1955 and 1956 seasons are shown on Tables 2 and 3. Effort was increased 10% between 1955 and 1956 and remained the same from 1956 to 1957. Total catch has increased each year. It is probable that this increase in total catch is due to a more advanced season (with warmer water temperatures) during 1956 and 1957 than in 1955. Unfortunately, the only temperatures recorded during the 1955 and 1956 seasons were the surface temperatures at each net set. Although these indicate warmer temperatures during each successive year's sample (for example, on Salmon Lake the average of the net temperatures was 52° F. in 1955, 60° F. in 1956 and 65° F. in 1957) they vary so widely that their true meaning cannot be determined. Maximum-minimum thermometer readings for May 15 through July 16, 1957 are shown on Table 4. The four thermometers used for these readings were all checked in July, 1957 against a thermometer which was certified by the U. S. Bureau of Standards and were found to be accurate within 0.5° F. This same type of temperature data will be taken during any future sampling periods.

Tables 5 through 8 show the average catch per net set for all three years' samples, and the fiducial limits of these average catches at the 95% level. Descriptions of the methods used to obtain these figures are given in last year's completion report for Job No. II, Project F-12-R-3. Table 9 is a summarization of the significance of the changes in ratio from 1955 to 1956, 1956 to 1957 and 1955 to 1957. Increases are recorded as a (+), decreases as a (-), and no significant change as a (o). The criterion for significance was no overlap of the limits of the ranges between the two ratios which are being compared. Further reviews of statistical methods and conferences with other workers in fishery statistics have convinced the writer that this criterion of significance is more logical than that used in last year's report.

Note that significant changes are indicated for only nine comparisons. All of these are either between the years 55-56, or 55-57. No significant changes are indicated between the years 56-57. It is believed that this is due to seasonal differences at time of sampling. In other words, the 1955 sampling was done when the season was less advanced than it was when the 1956 and 1957 samplings took place.

Table 10 shows a comparison of spring to summer netting on Inez and Rainy Lakes. Single figures are catch ratio means, and the figures in brackets are their fiducial intervals. Computation was by the same methods used for the data on Tables 5 through 8. No significant difference is indicated for cutthroat trout from either lake between spring and summer sampling periods.

Recommendations:

Following is a list of the special management practices which have been in effect on these six Clearwater Lakes since 1955.

Salmon Lake - planted yearly with 200/acre cutthroat fry.

Seeley Lake - planted yearly with 200/acre cutthroat fry.

Placid Lake - planted yearly with 200/acre cutthroat fry. Rough fish removed each year by trapping at inlet and outlet. This was done by a local sportsman's club and no records of numbers or pounds taken was kept.

Inez Lake - planted yearly with 200/acre cutthroat yearlings (2-5" fish).

Alva Lake - planted yearly with 500/acre cutthroat fry.

Rainy Lake - No special management.

All of these lakes were in the general Montana fishing season which runs from the last Sunday in May through November 30. The streams in the Clearwater drainage have been under a special late season opening (last Sunday in June) for the past three years. This late opening date has been used in several Montana cutthroat areas to prevent excessive pressure on lake cutthroat populations when they are concentrated in streams on their spawning run. It was done here merely to do everything possible for the management of the Clearwater drainage for cutthroat trout. The only indication we had of any trout concentrations in the streams was angler reports of good stream fishing in the drainage, only during the early part of the season.

No significant changes in the cutthroat catch ratio have occurred in any of the lakes during the three years of sampling. Neither does the statewide creel census indicate any increase in angler success on any of the six lakes during these three years. It is, therefore, recommended that the special management measures listed above be discontinued.

The following management plan is recommended for the Clearwater Drainage.

1. That portion of the drainage above Rainy Lake outlet, should be separated from the rest of the drainage by the construction of a barrier to upstream fish movement.

2. All squawfish, Columbia River chub, and yellow perch should be removed from this sub-drainage, by toxicants. This drainage section should then be replanted with rainbow trout.

3. A special creel census project should be operated on Rainy Lake for two years after it is restocked.

4. Fish populations should be sampled each year, in Rainy, Alva and Inez Lakes until two years after the upper drainage has been restocked. This sampling should be by the same method as used in the previous Clearwater netting jobs.

5. If, after rehabilitation, Rainy Lake shows a significantly higher trout catch ratio (by netting) and good fishing success (by angling) then the rest of the Clearwater Drainage should also be rehabilitated.

6. Rehabilitation of the rest of the drainage should proceed by sections - that is; by constructing barriers wherever they are feasible and rehabilitating the sub-drainages above them. this procedure is recommended for the following reasons:

a. The cost of rehabilitating the entire drainage would be too great for Montana's fishery budget in any one year.

b. A more thorough job can be done on a small section of a drainage than can be done on an entire, large drainage.

c. Rehabilitating the entire drainage at once would remove all angling from a large area. Rehabilitating by sections would insure some fishing in the area each year.

The barrier below Rainy Lake was constructed in the fall of 1957, and the toxification of the area above it is planned for the fall of 1958. As this season will be the last chance for obtaining pre-rehabilitation data, it is recommended that the standard netting be repeated on Rainy, Alva, and Inez Lakes this summer.

Prepared by A. N. Whitney and R. C. Averett   Approved by George D. Holton

Date April 17, 1958

TABLE I

125-FOOT OVERNIGHT NET SETS
CLEARWATER LAKES, JUNE 3-7, 1957

TOTAL CATCHES BY NUMBERS OF SPECIES

Lake	No. of Sets	CT	EB	RB	DV	KOK	WF	SQ	CRC	FSu	CSu	YP	PS	RSh	LMB	TOTAL
Salmon	20	0	0	0	7	0	119	145	102	79	53	644	5	0	0	1154
Seeley	25	34	0	1	35	5	146	167	76	85	89	257	56	0	0	951
Placid	25	6	32	0	12	4	320	73	155	103	19	0	578	0	5	1307
Inez	20	1	0	0	15	3	172	156	26	21	48	193	1	1	0	637
Alva	20	12	0	1	28	6	120	143	36	75	25	28	0	0	0	474
Rainy	10	8	0	0	14	0	164	47	43	32	32	21	0	0	0	361
TOTAL	120	61	32	2	111	18	1041	731	438	395	266	1143	640	1	5	4884

TABLE II

125-FOOT OVERNIGHT NET SETS
CLEARWATER LAKES, JUNE 17-22, 1956

TOTAL CATCHES BY NUMBERS OF SPECIES

Lake	No. of Sets	CT	EB	RB	DV	LL	KOK	WF	SQ	CRC	SQ X CRC	FSu	CSu	YP	PS	RSH	LMB	TOTAL
Salmon	20	4	0	1	3	2	2	81	164	71	0	96	86	760	15	0	1	1286
Seeley	25	19	0	0	30	0	1	148	174	71	0	92	101	415	59	0	2	1112
Placid	25	19	5	0	9	0	4	181	34	151	0	69	24	0	237	0	0	733
Inez	20	0	0	0	13	0	3	146	83	28	0	23	49	190	2	0	0	5[illegible]
Alva	20	2	0	0	17	0	0	100	197	28	0	91	51	31	0	0	0	5[illegible]
Rainy	10	5	0	0	12	0	0	106	52	49	1	45	27	56	0	1	0	354
TOTAL	120	49	5	1	84	2	10	762	704	398	1	416	338	1452	313	1	3	4539

TABLE III

125-FOOT OVERNIGHT NET SETS
CLEARWATER LAKES, JUNE 5-10, 1955

TOTAL CATCHES BY NUMBERS OF SPECIES

Lake	No. of Sets	CT	EB	RB	CT x RB	DV	KOK	WF	SQ	CRC	FSu	CSu	YP	PS	RSh	LMB	TOTAL
Salmon	20	1	0	0	0	7	0	52	170	110	56	49	323	5	2	0	775
Seeley	25	23	0	2	0	35	21	111	185	276	56	37	85	35	1	0	867
Placid	25	5	14	0	0	23	6	178	49	298	37	9	0	34	0	1	654
Inez	15	2	0	0	1	4	3	104	90	14	43	6	25	0	0	0	292
Alva	16	7	0	0	0	9	0	45	83	12	35	8	4	0	0	0	203
Rainy	9	5	0	0	0	8	1	84	49	23	33	21	8	0	0	0	232
TOTAL	110	43	14	2	1	86	31	574	626	733	260	130	445	74	3	1	3023

Maximum-minimum thermometer readings (in degrees F) from the outlets of four lakes in the Clearwater drainage; May 15 through June 16, 1957.

DATE	Salmon		Placid		Seeley		Alva	
May	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
15	52	48	54	44	54	50	53	46
17	53	48	56	44	55	49	52	48
19	54	49	60	52	57	50	54	47
21	54	48	55	48	54	46	53	48
23	52	48	58	48	54	47	58	49
25	53	47	59	51	55	48	58	49
27	53	50	57	53	59	51	60	50
29	58	50	62	52	61	51	62	50
30	56	54	68	57	61	51	62	54
June								
1	59	58	68	54	65	54	63	53
2	61	57	70	63	66	54	--	--
3	62	57	72	62	66	59	68	62
4	--	--	72	63	72	54	--	--
6	65	58	71	65	72	53	69	59
7	63	59	68	64	62	58	66	60
9	63	57	69	63	66	57	67	60
11	63	55	68	62	65	59	65	59
14	62	57	66	58	64	57	63	59
16	60	56	62	57	62	54	62	58

Note: -- = no reading taken
All readings represent the period starting at the time of the previous reading.

TABLE IV

TABLE V

SPRING NETTING - 1955, 1956 and 1957

SALMON, SEELEY AND PLACID LAKES

AVERAGE CATCH PER NET SET AND FIDUCIAL INTERVALS AT THE 95% CONFIDENCE LEVEL

LAKE	YEAR	CT	DV	WF	YP	PS
	1955	0.1 (0.0-0.2)	0.4 (0.1-0.7)	2.6 (1.0-4.2)	16.2 (8.0-24.4)	0.3 (0.1-0.5)
Salmon	1956	0.2 (0.0-0.4)	0.2 (0.0-0.4)	4.1 (1.8-6.4)	38.0 (16.8-59.2)	0.8 (0.0-1.6)
	1957	None	0.4 (0.3-0.5)	6.0 (4.3-7.7)	32.2 (15.0-49.4)	0.3 (0.0-0.6)
	1955	0.9 (0.5-1.3)	1.4 (0.7-2.1)	4.4 (2.8-6.0)	3.4 (1.7-5.1)	1.4 (0.5-2.3)
Seeley	1956	0.8 (0.2-1.4)	1.2 (0.6-1.8)	5.9 (3.4-8.4)	16.6 (8.8-24.4)	2.4 (1.8-3.0)
	1957	1.4 (0.4-2.4)	1.4 (1.0-1.8)	5.8 (3.3-8.3)	10.3 (5.4-15.2)	2.2 (0.2-4.2)
	1955	0.2 (0.0-0.4)	0.9 (0.6-2.2)	7.1 (5.0-9.4)	None	1.4 (0.4-2.4)
Placid	1956	0.8 (0.2-1.4)	0.4 (0.2-0.6)	7.2 (5.2-9.2)	None	9.5 (2.9-16.1)
	1957	0.3 (0.2-0.4)	0.5 (0.3-0.7)	12.8 (7.1-17.7)	None	23.1 (13.1-33.1)

TABLE VI

SPRING NETTING - 1955, 1956 and 1957

SALMON, SEELEY AND PLACID LAKES

AVERAGE CATCH PER NET SET AND FIDUCIAL INTERVALS AT THE 95% CONFIDENCE LEVEL

LAKE	YEAR	SQ	CRC	FSu	CSu
Salmon	1955	8.5 (4.7-12.3)	5.5 (2.1-8.9)	2.8 (1.4-4.8)	2.5 (0.5-4.5)
	1956	8.2 (2.6-13.8)	3.6 (1.6-5.6)	4.8 (2.0-7.6)	4.3 (2.1-6.5)
	1957	7.3 (2.9-11.7)	5.1 (1.6-8.6)	4.0 (1.4-6.6)	2.7 (0.7-4.7)
Seeley	1955	7.4 (5.6-9.2)	11.0 (8.2-13.8)	2.2 (1.3-3.1)	1.5 (0.9-2.1)
	1956	7.0 (6.1-7.9)	2.8 (1.4-4.2)	3.7 (2.7-4.7)	4.0 (3.3-4.7)
	1957	6.7 (3.2-10.2)	3.0 (1.2-4.8)	3.4 (2.2-4.6)	3.6 (2.1-5.1)
Placid	1955	2.0 (1.3-2.7)	11.9 (7.2-16.6)	1.5 (0.6-2.4)	0.4 (0.9-2.1)
	1956	1.4 (0.4-2.4)	6.0 (2.5-9.5)	2.8 (0.5-5.1)	1.0 (0.4-1.6)
	1957	2.9 (1.6-4.2)	6.2 (2.7-9.7)	4.2 (2.3-6.1)	0.8 (0.3-1.3)

TABLE VII

SPRING NETTING - 1955, 1956 and 1957

INEZ, ALVA AND RAINY LAKES

AVERAGE CATCH PER NET SET AND FIDUCIAL INTERVALS AT THE 95% CONFIDENCE LEVEL

LAKE	YEAR	CT	DV	WF	YP	PS
	1955	0.1 (0.0-0.3)	0.3 (0.0-0.6)	6.9 (3.9-9.9)	1.7 (0.2-3.2)	None
Inez	1956	None	0.7 (0.4-1.0)	7.3 (4.0-10.6)	9.5 (3.2-15.8)	0.1 (0.0-0.3)
	1957	0.1 (0.0-0.1)	0.8 (0.4-1.2)	8.6 (6.1-11.1)	9.7 (1.7-17.7)	0.1 (0.0-0.1)
	1955	0.4 (0.0-0.9)	0.6 (0.2-1.0)	2.8 (1.0-4.6)	0.3 (0.0-0.7)	None
Alva	1956	0.1 (0.0-0.3)	0.9 (0.5-1.3)	5.0 (3.3-6.7)	1.6 (0.8-2.4)	None
	1957	0.6 (0.2-1.0)	1.4 (0.5-2.3)	6.0 (3.7-8.3)	1.4 (0.0-2.8)	None
	1955	0.6 (0.0-1.3)	0.9 (0.0-1.8)	9.3 (5.2-13.4)	0.9 (0.2-1.6)	None
Rainy	1956	0.5 (0.0-1.0)	1.2 (0.1-2.3)	10.6 (8.1-13.1)	5.6 (0.0-15.6)	None
	1957	0.8 (0.0-1.7)	1.4 (0.0-2.8)	16.4 (9.6-23.2)	2.1 (0.0-4.8)	None

TABLE VIII

SPRING NETTING - 1955, 1956 and 1957

INEZ, ALVA AND RAINY LAKES

AVERAGE CATCH PER NET SET AND FIDUCIAL INTERVALS AT THE 95% CONFIDENCE LEVEL

LAKE	YEAR	SQ	CRC	FSu	CSu
Inez	1955	6.0 (3.2-8.6)	0.9 (0.2-1.6)	2.9 (0.4-5.4)	0.4 (0.0-0.8)
	1956	4.2 (1.9-6.5)	1.4 (0.4-2.4)	1.2 (0.2-2.2)	2.5 (0.6-4.4)
	1957	7.8 (2.1-13.5)	1.3 (0.0-2.7)	1.1 (0.1-2.1)	9.7 (0.0-2.0)
Alva	1955	5.2 (3.0-7.4)	0.8 (0.1-1.5)	2.2 (1.1-3.3)	0.5 (0.1-0.5)
	1956	9.9 (4.7-15.1)	1.4 (0.4-2.4)	4.6 (2.7-6.5)	2.6 (0.3-4.9)
	1957	7.2 (2.7-11.7)	1.8 (0.3-3.3)	3.8 (2.2-5.4)	1.3 (0.3-2.3)
Rainy	1955	5.4 (2.4-8.4)	2.6 (0.4-4.8)	3.7 (1.3-6.1)	2.3 (0.4-4.2)
	1956	5.2 (1.6-8.8)	4.9 (0.0-10.1)	4.5 (1.6-7.4)	2.7 (0.7-4.7)
	1957	4.7 (2.4-7.0)	4.3 (0.8-7.8)	3.2 (0.0-6.9)	3.2 (0.4-6.0)

LAKE		CT	DV	WF	YP	PS	SQ	CRC	FSU	CSU
SALMON	1955-56	o	o	o	o	o	o	o	o	o
	1955-57	o	o	+	o	o	o	o	o	o
	1956-57	o	o	o	o	o	o	o	o	o
SEELEY	1955-56	o	o	o	+	o	o	-	o	+
	1955-57	o	o	o	+	o	o	-	o	o
	1956-57	o	o	o	o	o	o	o	o	o
PLACID	1955-56	o	o	o	N	+	o	o	o	o
	1955-57	o	o	o	N	+	o	o	o	o
	1956-57	o	o	o	N	o	o	o	o	o
INEZ	1955-56	o	o	o	o	o	o	o	o	o
	1955-57	o	o	o	o	o	o	o	o	o
	1956-57	o	o	o	o	o	o	o	o	o
ALVA	1955-56	o	o	o	+	N	o	o	o	o
	1955-57	o	o	o	o	N	o	o	o	o
	1956-57	o	o	o	o	N	o	o	o	o
						N				
RAINY	1955-56	o	o	o	o	N	o	o	o	o
	1955-57	o	o	o	o	N	o	o	o	o
	1956-57	o	o	o	o	N	o	o	o	o

TABLE NO. IX

Direction of significant change in Average Catch per net from 1955-56, 1955-57 and 1956-57, from fiducial limits on Tables 5 through 8. (+) = significant increase, (-) = significant decrease, (o) = no significant change, (N) = no fish taken in either year's sample.

TABLE X

COMPARISON OF SPRING TO SUMMER NETTING OF INEZ AND RAINY LAKES, 1957

LAKE	YEAR	TIME OF NETTING	CT	DV	WF	SQ	CRC	SU	YP	PS
Inez	1957	June 3-7	0.1 (0.0-0.1)	0.8 (0.4-1.2)	8.6 (6.1-11.1)	7.8 (2.1-13.5)	1.3 (0.0-2.7)	8.9 (3.0-14.8)	9.7 (1.7-17.7)	0.1 (0.0-0.1)
		July 28-Aug. 2	0.4 (0.3-0.5)	1.8 (0.8-2.8)	11.9 (6.0-17.8)	8.8 (4.0-13.6)	0.5 (0.0-1.1)	5.2 (2.9-7.5)	10.4 (2.7-18.1)	None
Rainy	1957	June 3-7	0.8 (0.0-1.7)	1.4 (0.0-2.8)	16.4 (9.6-23.2)	4.7 (2.4-7.0)	4.3 (0.8-7.8)	6.4 (0.0-13.0)	2.1 (0.0-4.8)	None
		July 28-Aug. 2	1.1 (0.0-2.2)	0.5 (0.3-0.7)	9.0 (0.6-17.4)	9.5 (5.0-14.0)	3.0 (0.8-5.2)	5.2 (2.0-8.4)	8.1 (0.0-20.1)	None

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JOB COMPLETION REPORT
INVESTIGATIONS PROJECTS

State of Montana

Project No. F-12-R-3 Name Western Montana Fishery Study

Job No. IV Title Rock Creek Placer Mining Study

Period Covered May 1, 1956 - November 1, 1956

Abstract

A placer mine was proposed on the West Fork of Rock Creek in the summer of 1955. This job was set up to obtain information on the water quality and on the fish population of that stream prior to the mining operation.

Four stations were selected, both within and below the site of the proposed mine. Turbidity samples were taken once each month from accessible stations. Four 300-foot sections of the stream were sampled by electro-fishing.

No work was done on the mining claim in 1956, and it has been reported that the prices of the "rare earths", which were to have been mined, have fallen to the point where the operation would no longer be profitable.

It is recommended that this job be discontinued until such time as the mining operation may again be undertaken.

Objectives

To measure the effects of a new placer mining operation on the water, flora and fauna of Rock Creek.

Techniques Used

In the summer of 1955, it was reported that a placer mining operation was planned in the Sand Basin area of the West Fork of Rock Creek. The location of this area is T5N, R17W, S10 & 15, Granite County, Montana. The basin is at an elevation of over 5000 feet in the Sapphire Mountains, and is about two miles south of the Skalkaho road. This road is the only one serving the area, and is usually blocked by snow from November to June of each year.

The area was investigated in the summer of 1955 and it was found that a new access road had been built from the Skalkaho road into Sand Basin and that several small excavations had been made in the basin itself. These excavations were not near the stream's edge and had no function other than to allow the mining company to show a certain amount of work done in order to keep their claims. It was reported that the Moose Horn Mining Company planned to move a dredge into the basin in the summer of 1956 and to start placer mining operations for certain "rare earths".

Four stations were selected from which samples were to be collected once each month for turbidity analysis. These stations were located as follows: Station four was in Sand Basin at the general area of the proposed dredge operation, T5N, R17W, S15, Granite County; station two was about one mile downstream from station four, just off the new access road, T5N, R17W, S2, Granite County, stations one and three were about eight and ten miles below Sand Basin, along the main Skalkaho road, T6N, R16W, S35 and T6N, R15W, S31 respectively. Sampling began in February, 1956 and samples were taken from accessible stations once each month through December 1956. Stations two and four were not accessible for November and December collections and only station one was accessible from February through May.

The samples taken during February through May were analyzed on a Hellige turbidometer at the Department's fishery laboratory in Bozeman. In May of 1956, the Montana State Board of Health requested that all further samples be sent, because our sampling concerned pollution, to their laboratory in Helena. Project personnel complied with this request.

On July 16 and 17, 1956 four 300-foot sections of the West Fork of Rock Creek were sampled by electro-fishing. Sections one, two and three were adjacent to one another, and were within the placer mine claim in Sand Basin. Section four was about four miles below the basin. An attempt was made to sample sections on the North Fork of Rock Creek, which is a small tributary of the West Fork. This stream is outside the proposed placer mining operation and it was felt that sample stations on it could be used as controls for the stations on the West Fork. However, fish were found to be so scarce in this small stream that electro-fishing catch records from it would have had no value for control data.

The mining company did no further work in the area in the summer of 1956 and it was reported that the "rare earths", which were to have been mined, had fallen in price so that the proposed operation no longer appeared profitable.

Findings

Readings from the turbidity samples which were analyzed at the Bozeman laboratory are show in Table 1. No such comparable data were obtained from the Board of Health laboratory. The Board of Health stated that they considered all turbidities of less than 10 ppm as a trace and reported the June and July samples in that manner. All samples from August through December, 1956 were analyzed for ppm dissolved solids instead of turbidity. No reason for this change was given. These readings are shown in Table 2.

The West Fork of Rock Creek in Sand Basin was found to have several characters unusual for a high mountain stream. The basin itself is a high mountain meadow, and the stream within it has a fairly moderate gradient, grass-lined banks, mostly sand bottom and little shade cover from brush or trees. This is in sharp contrast, both to most of our other mountain streams and also to the West Fork itself, after it leaves the basin. These other streams are usually characterized by having steep gradients, boulder and rubble banks and stream beds, and good shade cover from brush, trees and high cliffs.

It was reported that a Civilian Conservation Corps (CCC) crew under the direction of Dr. Tarzewell, had done stream improvement work in this area in the early 1930's. During the 1956 survey, many of these old structures were located. A few of them were still functioning, particularly the ones which had been deisgned to furnish submerged cover.

The first sampling attempt was made in June, with the 230-volt DC generator from project F-13-R. Practically no fish were taken. A second attempt was made on July 16 and 17 with both the DC machine and the 230-volt AC generator from this project. The three sections within Sand Basin (numbers 1, 2 and 3) were each done with both generators in the following manner:

Sec. 1 - one downstream run with the DC unit followed by an upstream and downstream run with the AC unit.

Sec. 2 - one upstream and downstream run with the AC unit followed by one downstream run with the DC unit.

Sec. 3 - two downstream runs with the DC unit followed by one upstream and one downstream run with the AC unit.

Section 4 was sampled with the AC machine only. The numbers of fish taken from each section by each generator are shown on Table 3. It is quite apparent, upon consideration of these data, that in this particular stream the AC unit is far superior to the DC as a sampling device.

Recommendations

Because the proposed placer mining operation on the West Fork of Rock Creek has not been undertaken, the major portions of this study should be discontinued until such time as the mining operation starts.

It would be well to have electro-fishing data from several sections, on both the West Fork and the main Rock Creek, well below Sand Basin. It is recommended that this suggested sampling be done under the regular survey, which is to be carried out under a state project in 1957.

It is further recommended that the turbidity samples be collected from all accessible stations once each month from June through December of 1957. These should be run on the turbidometer at the Bozeman laboratory in order to obtain June through December data comparable to the February through May data collected in 1956.

Summary

1. In the summer of 1955, it was reported that a placer mining operation was contemplated on the West Fork of Rock Creek. Investigation disclosed that a new access road had been built into the Sand Basin area of this creek, and that several small excavations had been made in order for the company to maintain its claim.

2. Turbidity samples were collected once each month from the West Fork of Rock Creek from February through December, 1956. These were collected from one to four stations each month, depending upon the accessibility of the higher areas.

3. February through May samples were analyzed at the Department's Fishery Laboratory at Bozeman. June through December samples were sent to the Montana State Board of Health in Helena.

4. Four 300-foot sections of the West Fork of Rock Creek were sampled by electro-fishing.

5. The proposed mining operation was not undertaken in 1956. The reason proposed for this was that the prices of the "rare earths", which were to have been mined, had fallen to the point where the mining operation would no longer be profitable.

6. The following recommendations are given:

a. This job should be discontinued until such time as mining starts in Sand Basin.

b. Several sections in the lower parts of Rock Creek drainage should be sampled by electro-fishing in 1957. This should be done under a regular survey job.

c. Turbidity samples should again be collected from June through December, 1957 and should be analyzed at the Bozeman Fishery Laboratory. This also should be done under the survey job.

Data and Reports

The original data and reports are with the project leader in Missoula.

Prepared by Arthur N. Whitney

Approved George D Holton
GEORGE D. HOLTON

Date May 5, 1957

Table No. 1 Turbidity readings, Station 1, West Fork Rock Creek, 1956. Stations 2, 3 and 4 were inaccessible from February through May.

Date	Turbidity (ppm SiO_2)
February 3, 1956	2.5
March 23, 1956	0.5
April 12, 1956	1.5
May 2, 1956	1.0
May 19, 1956	3.2

Table No. 2 ppm dissolved solids, West Fork Rock Creek, 1956. Stations 2 and 4 were inaccessible in November and December.

	Station			
Date	1	2	3	4
July 17, 1956	18.3	18.0	29.2	16.0
August 7, 1956	22.7	22.5	33.5	23.3
August 31, 1956	17.8	33.0	33.5	18.7
October 26, 1956	26.5	18.8	36.8	20.0
November 28, 1956	29.8		76.0	
December 18, 1956	23.0		44.0	

Table No. 3. Catch per 300' section by type of electro-fishing device, West Fork Rock Creek.

	Section						
	1		2		3		4
Species	AC	DC	AC	DC	AC	DC	AC only(DC not used)
Cutthroat Trout	4	0	10	0	10	0	2
Dolly Varden trout	0	1	3	0	3	0	11
Mountain whitefish	2	0	20	0	28	1	2
Fine-scaled sucker	0	0	3	0	10	0	1
Cottus	9	0	18	0	5	0	1
TOTAL	15	1	54	0	56	1	17

MONTANA STATE DEPARTMENT OF FISH AND GAME
FEDERAL AID IN FISH RESTORATION SECTION
HELENA, MONTANA

JOB COMPLETION REPORT
INVESTIGATIONS PROJECTS

State of Montana

Project No. F-12-R-3

Job No. III

Period Covered June 1, 1956 to November 15, 1956

Name Western Montana Fishery Study

Title Life History Study of the Squawfish (Ptychocheilus Oregonensis) and Columbia River Chub (Mylocheilus Caurinus) in the Blackfoot River Drainage.

Abstract:

The Oregon Squawfish and Columbia River chub are being studied in the Big Blackfoot drainage. The chub is largely restricted to the Clearwater drainage and its lakes. The squawfish is largely restricted to the Clearwater drainage, and the main fork of the Big Blackfoot river. Collection was begun too late in 1956 to determine the time of spawning. Data was collected for the determination of age and growth, age of maturity and fecundity. Difficulty was encountered in collecting individuals under 7 inches in length. Recommendations for continuation of the study are given.

Objectives:

The construction of a proposed dam at Ninemile Prairie would inundate a considerable portion of the Big Blackfoot river and would create an impoundment which, if it follows the pattern of such impoundments in the past, will provide a habitat more suited for rough fish than for game species. Therefore, it is desirable to consider the removal of rough fish in the drainage in the event that such a dam is constructed. The purpose of this study is to gather information on the life history and distribution of the two most important rough fish species of the drainage in order to determine the feasibility of such an eradication and to implement its planning.

Techniques and Findings:

Distribution:

Distribution was investigated by gill netting, seining, shocking and concussion sampling.

Columbia River chubs were found in all lakes of the Clearwater drainage which have been sampled, except in lakes Summit, Clearwater and Marshall. These three lakes are all near various headwater portions of the drainage. Chubs were found in the Clearwater river between Salmon lake and the mouth of this river, but no chubs were found in the Big Blackfoot river where it was sampled or in any of the other tributaries above the proposed dam site. The area of the Blackfoot samples extends from a point about 2 miles upstream from a bridge known as Scotty Brown's bridge, located between Ovando and Clearwater junction, to a point about 2 miles below Lincoln.

Squawfish were collected in all lakes of the Clearwater chain. None were collected in Marshall lake. Squawfish were collected in the Clearwater river between Salmon lake and the mouth of this river and in the Big Blackfoot up to a point about 3 miles upstream from the mouth of Arrastra creek. Most of the tributaries between this point and the proposed dam site were checked by shocking and no squawfish were taken. No squawfish were collected in four overnight gill net sets in Nevada creek reservoir. Although dead squawfish were found on the shore of Cooper's lake, the outlet of which is a tributary of the North Fork of the Blackfoot, no squawfish were collected in the North Fork.

Reproduction:

All fish collected were classified according to sex, maturity, and gonad condition. This data was recorded on the envelopes in which the scale samples were placed.

Age of maturity will be determined when the scales are read for age and growth determination.

Time of spawning was not determined in 1956, since collection did not begin until after the spawning season of both species was in progress.

On June 14, the first day of collection, 8 Or 9 mature female chubs collected in Placid lake were spent. On June 18, all of the 28 mature female chubs collected in this lake were spent, as were all of those collected after this date.

Although difficulty was encountered in interpreting the ovary condition of squawfish, the spawning season was evidently in progress when collection began on June 14. About 32 overnight gill net sets were made on Seeley lake in late March, 1957. Female squawfish collected at this time exhibited a wide variation in ovary development. The largest specimen collected was among the group showing the least amount of development. This condition suggests that mature individuals may not all spawn in any one year.

Fecundity of females will be determined by making egg counts on ovaries collected from 17 squawfish and 8 chubs collected in March, 1957.

Location of spawning and spawning habits were not determined. No observations of spawning were made and no concentrations of youngof the year were found.

Age and Growth:

In addition to data from Job II, collections were made through the summer of 1956 by gill netting, seining and angling. Thirty-two overnight sets, with 125 foot experimental gill nets, were made in Placid lake; 32 in Alva lake and 18 in Seeley lake. Gill netting was also carried out in Marshall and Summit lakes. Scale samples with data on sexual condition, length and weight were retained on 564 squawfish and 500 chubs collected by gill netting. Nearly all these specimens were over 7 inches long. Attempts to collect fish under this size in the lakes were unsuccessful. Seining was attempted in Alva, Seeley and Placid lakes on several occasions and a 25 foot section of 5/16 inch square mesh gill net was set in these lakes. Few small fish were taken. A concentration of small squawfish was found in a diversion pond on the Clearwater river below Salmon lake and several hundred specimens ranging from yearlings to approximately 8 inches in total length were collected. These were preserved and scale samples will be taken from them.

Gum arabic mounts have been made of scales from 313 chubs from Placid lake. These will be read when smaller individuals have been obtained for interpretation of scale formation and development.

A similar series of scales of squawfish from Seeley lake will be mounted and smaller groups of both species from other parts of the drainage will be mounted and read for comparing growth rates within the drainage.

Considerable time was spent searching for young of the year by wading shorelines and streams. No concentrations were found and few were collected.

Recommendations:

It is suggested that the study be continued for another year.

Collection should begin by June 1 in order to determine the spawning period. Maximum-minimum temperature stations should be set up in the water at the following places in order to correlate water temperature with spawning: at the bridge over Owl creek at the outlet of Placid lake, at the bridge of the lakeshore road over the Clearwater river at the outlet of Seeley lake, and at the bridge of the Harper place driveway over the Clearwater river just above state highway No.20. These temperature stations should be established by May 15, 1957 and temporary local help should be hired, if necessary, to read the thermometers at least on alternate days until the student assistant is able to resume work on or about June 1.

Ripe individuals taken in collections should be spawned and the eggs retained in Mason jars with cheesecloth covers. These jars should be placed in the water where they are not apt to be disturbed and the development of the eggs observed.

Attempts to observe spawning fish should be continued.

More intense efforts should be made to collect young of the year fish and fish of smaller size groups. The latter will be aided by additional equipment which is in preparation. A pirate trap of 1/4 inch square mesh is being made and gill nets with mesh sizes of 3/8 inch to 5/8 inch have been ordered.

Data collected during the summers of 1956 and 1957 should be analyzed during the winter of 1957-58.

Summary:

1. The purpose of this study is to gather information on the life history and distribution of the Oregon squawfish and Columbia River chub in the Big Blackfoot drainage above the proposed Ninemile Prairie damsite. This is deemed necessary in order to determine the feasibility of a rehabilitation project designed to eliminate these species from the drainage above the damsite, and to implement the planning of such a project.

2. Columbia River chubs were found in all lakes of the Clearwater drainage which have been sampled, except in lakes Summit, Clearwater and Marshall. These three lakes are all near various headwater portions of the drainage. Chubs were also taken from the Clearwater River below Salmon Lake. They were not taken from the Big Blackfoot River, nor from any of its tributaries which were sampled above the proposed damsite.

3. Squawfish were taken from all the lakes which have been sampled in the Clearwater drainage except lakes Marshall and Clearwater. They were also taken from the Big Blackfoot River as far as a point about 65 miles above the proposed damsite. Squawfish were not taken from any of the tributary streams along this section of the Blackfoot. They were taken from Cooper's Lake, but not from the North Fork of the Blackfoot River, into which the outlet of Cooper's Lake drains.

4. Sex, maturity, and gonad condition were recorded for all squawfish and chubs which were collected. Age of maturity will be determined when age and growth analysis of scale samples has been completed.

5. The time of spawning was not determined because the 1956 collections did not begin until after the spawning periods of both species were in progress. Wide variations in gonad condition of female squawfish collected in March, 1957 suggests that the mature individuals of this species may not all spawn in any one year.

6. No concentrations of spawning adults, or of young of the year were found for either squawfish or chubs.

7. Scale samples were taken from 564 squawfish and 500 chubs. These fish were collected both during Job No. II, and by repeated netting throughout the summer. Nearly all specimens from which scale samples have been taken were over 7 inches total length. Attempts to collect fish under this size from the lakes have been unsuccessful. Several hundred small squawfish (from yearling to about 8 inches in size) were collected from a diversion pond on the Clearwater River below Salmon Lake.

8. The age and growth analysis of scale samples has not been completed.

9. Recommendations are as follows:
   a. The study should be continued for another year.
   b. Collections should begin at least by June 1, 1957.
   c. Maximum-minimum thermometer stations should be established in several of Clearwater Lakes' outlets by mid-May.
   d. Eggs from ripe squawfish and chubs should be collected and fertilized. These should be retained in jars in protected areas and checked for development.
   e. More intense efforts should be made to observe spawning fish and to collect young of the year and other small fish groups.
   f. 1956 and 1957 data should be analyzed during the winter of 1958-59.

Prepared by Cliff W. Hill, Jr.

Date March 31, 1957

Approved George D. Holton

MONTANA STATE DEPARTMENT OF FISH AND GAME
FEDERAL AID IN FISH RESTORATION SECTION
HELENA, MONTANA

JOB COMPLETION REPORT
INVESTIGATIONS PROJECTS

State of Montana

Project No. F-12-R-3 — Name Western Montana Fishery Study

Job No. II — Title Comparisons of Fish Populations of Six Clearwater Lakes

Period Covered October 1, 1956 to March 30, 1957

Abstract:

The six main Clearwater Lakes were netted simultaneously by six survey crews on June 17-22, 1956. Each crew followed the same daily schedule, and net sets were made at the same locations in each lake at which they were made in 1955. All fish captured were weighed, measured and recorded. Scale samples were taken only from species for which additions to the 1955 collections were necessary.

The average catch per net set was computed for each species in each lake. The 1955 and 1956 samples are compared by these average catches and their fiducial limits at the 95% confidence level. A significant increase in catch is indicated for both species of suckers, for yellow perch and for pumpkinseed sunfish on several lakes. A significant decrease in catch is indicated for Columbia River chub on two lakes. Two possible reasons are proposed for these changes. These are: an increase or decrease in fish numbers, or a change in fish activity with a later sampling date in 1956.

No significant changes between the two samples are indicated for cutthroat trout, and it is recommended that these two years' data be used as a basis for future evaluation of cutthroat management measures on these lakes. It is further recommended that this job be repeated in 1957 and in 1958, and that the evaluation of the management measures in 1958-59 be based on the comparison of the four years' data.

Objectives:

The object of this job was to obtain comparative netting data on the six main Clearwater lakes for a second year. The objectives of the first netting job were to obtain the best possible figures on the present fish populations of these lakes, ---as a basis for the evaluation in the future of management measures which vary from lake to lake, but which remain the same from year to year. The advantage of the two consecutive years' date lies in having a comparison of the change in catch between two seasons' samplings with a minimum of change in the fish populations. Or, stated in a different manner, two consecutive years' data were to be used to determine if this sampling technique would provide data which would be useable for the future evaluation of certain management measures.

Techniques Used:

Three standard experimental gill nets (one 250 feet and two 125 feet long) were set overnight in Placid Lake on June 13-14 and in Seeley Lake on June 14-15. In each lake

the 250 foot net was set deep (over 70 feet) and the two 125 foot nets were set shallow (less than 25 feet). All fish captured were recorded, weighed and measured. Chubs and squawfish were checked for gonad condition and scale sampled for use in the life history study of these species. The result of this preliminary netting is shown on Table 1. It is apparent that at the time of year these samples were taken, the shallow water sets captured more fish of the same species than did the deep water sets. Therefore, the crews on the regular netting were instructed to make shallow water sets only.

On June 17, six two-man crews assembled in the Seeley Lake area with netting equipment, and the first net sets were made before dark. Nets were lifted and re-set on June 18, 19, 20 and 21, and were lifted and removed on June 22. Pertinent data on each set was recorded on Montana's standard netting forms. Each crew was furnished with a map of its respective lake, upon which the locations of the 1955 net sets had been marked. In 1956, each individual net set was made at the location shown for that particular set in 1955. Exactly the same personnel who worked on the 1955 netting job could not be obtained for the 1956 sampling. However, in 1956 the crew for each Lake was composed of at least one of the individuals who had worked on that particular lake in 1955. All nets used were 125 foot nylon experimental gill nets, which consist of five equal sections of one and one-half, two, two and one-half, three and four inch stretch measure mesh. The following number of nets were used in each lake: Salmon - 4, Seeley - 5, Placid - 5, Inez - 4, Alva - 4, and Rainy - 2.

The following daily schedule was used by all crews: Nets were lifted, all fish were worked, nets were mended when necessary and nets were re-set. All fish captured were weighed, measured and recorded. Because approximately 50 scale samples had been collected for each species taken during the 1955 netting, no attempt was made to repeat the collections for all species in 1956. Scale samples were taken in 1956 from the following three categories of fish: (1) from most of the squawfish and Columbia River chubs, for use in the life history studies of these species; (2) from species whose 1955 scale samples totaled less than 50 individuals, up to a total of 50 samples for both years; (3) from size groups of various species, which were short or missing in the 1955 collections. Before this netting project started, the project leader reviewed the 1955 scale sample collections and compiled a list of the sizes and species of fish from which samples would be required in 1956. Each crew was furnished one of these lists for their respective lake before the start of the 1956 collections.

Findings:

Following is a list of abbreviations used on the tables in this report, common names and scientific names of the species of fish taken during the netting project:

Abbreviation	Common Name	Scientific Name
CT	Cutthroat trout	*Salmo clarkii*
EB	Eastern brook trout	*Salvelinus fontinalis*
RB	Rainbow trout	*Salmo gardnerii*
DV	Dolly Varden trout	*Salvelinus malma*
LL	Brown trout	*Salmo trutta*
KOK	Kokanee	*Oncorhynchus nerka*
WF	Mountain whitefish	*Prosopium williamsoni*
SQ	Squawfish	*Ptychocheilus oregonensis*
CRC	Columbia River chub	*Mylocheilus caurinus*
FSu	Fine-scaled sucker	*Catostomus catostomus*
CSu	Coarse-scaled sucker	*Catostomus macrocheilus*
YP	Yellow perch	*Perca flavescens*
PS	Pumpkinseed sunfish	*Lepomis gibbosus*
RSh	Red-sided shiner	*Richardsonius balteatus*
LMB	Largemouth bass	*Micropterus salmoides*

The age and rate of growth analysis has not been completed for scale samples taken in 1956. Therefore, no revisions in the previous age and growth data can be made. Because these data were presented in detail in the report on the 1955 netting job, they are not repeated here.

The total number of 125-foot overnight net sets made in each lake and the total catches by numbers of species are shown for each lake in Table 2. This same information is repeated from the report on the 1955 sampling in Table 3. Note from these two tables, that while the total effort (number of net sets) was increased by only 10% from 1955 to 1956, the total number of fish captured in 1956 was 50% greater than in 1955. Although this change in total catch appears quite large, the results of the statistical analysis of the individual net catches by species show that, at the 95% confidence level, these changes are indicative of an actual change in catch rates in only a very few cases.

Table 4 shows the average catch per net set, for both years' samples, of the 9 species which were most numerous in both collections. This figure was computed by dividing the total catch of one species in one lake by the total number of net sets made in that particular lake. No allowance was made for slight variations in the total hours' duration between sets. These differences were slight as all sets followed the same general daily schedule of lifting and re-setting. Therefore, it was only during the fairly unproductive mid-day hours that any of the nets were not fished. This average catch per net set has been referred to by various other workers, both as catch per net night and also as gill net ratio, although gill net ratio has also been used to describe a catch figure based on hours rather than days. In order to avoid excessive repetition of words, the average catch figures will hereafter be referred to in this report simply as ratio.

Table 4 also gives the fiducial intervals of these ratios at the 95% confidence level. These were computed by the procedure described on page 64, Snedecore, 1946. Table 5 shows a summarization of the significance of these changes in ratio from 1955 to 1956. The observed ratio for each year was compared to the fiducial interval of the other years's ratio. If neither of the observed ratios fell within the limits to which they were compared, then the change in ratio was regarded as significant and was recorded as either + for an increase or - for a decrease. If either or both of the two ratios fell within the limits to which they were compared, then the change was regarded as not significant and was recorded as o.

The significant increases in ratios from 1955 to 1956 are limited chiefly to the two species of suckers, the perch and the sunfish, while the significant decreases are limited primarily to the chubs. Note that except for dolly varden, although a significant change in ratio is not constant for any one species in all the lakes, any species that shows a significant change in one or more lakes shows no significant change in the opposite direction in any other lake.

Gill nets are passive fishing gear, which depend for their catch, both upon numbers of fish present and upon the movement of those fish. Therefore, two possible reasons must be considered for the significant increases in the catch ratios of the suckers, perch and sunfish. First, they could be due to an actual increase in numbers of these species in their respective lakes, (i.e. strong year classes of fish just becoming available to our sampling gear). Second, they could be due to warmer temperatures during the 1956 netting period causing greater activity among these fish than occurred during the 1955 sampling period. The 1955 sampling took place from June 5-10, and the 1956 sampling from June 17-21. These same two reasons (change in fish numbers or change in fish activity) may also be considered for the significant decrease in the Columbia River chub ratios in Seeley and Placid Lakes. These changes could be due to an actual decrease in number of chubs available to our sampling gear in these two lakes. They could also be due to a decrease in activity of chubs in the lakes. Although a decrease in activity with a later spring sampling date may sound odd at first, there is a possibility that it occurred in this case. Of 37 adult female chubs examined from the 1956 catch on Placid Lake, 26 were

spent and 1 was ripe. Records of the famale chub gonad condition were not taken from the 1955 catch. However, with the 1955 sampling occurring one week earlier than the 1956 sampling, it is quite possible that the first year chub samples were taken during the main spawning period of these fish. This could account for their higher catch ratios in 1955 than in 1956 on Placid and Seeley lakes.

If increased or decreased activity of the fish, due to time of sampling, is the correct reason for the significant changes in catch ratio, then the question arises of why the same significant changes did not occur for any one species on all the lakes. No definite reason can be given for this, however, it is well to remember that by showing no significant change in ratios, the statistical analysis used here does not mean difinitely that no change has taken place. What the analysis does mean in these cases, is that any changes that have occurred cannot be reliably shown by our sampling technique. With this in mind, note that the gill net ratio rose (significantly in eight case and not significantly in the other seven) for coarse-scaled suckers, yellow perch and pumpkinseed sunfish in all the lakes where these species were taken.

On the other hand, the Columbia River chub ratio did not fall on all lakes. As mentioned above, the only significant change was the ratio's drop on Seeley and Placid lakes. It also dropped on Salmon Lake, but it rose on Inez, Alva and Rainy lakes. Although these latter changes are not significant and therefore need no justification, the following explanation can be considered. The three lakes in which the chub catch rose are uppermost in the drainage. Chub spawning appears to be a short duration. It is possible that during the 1955 netting the chubs were spawning on the lower three lakes and not on the upper three; and that during the 1956 netting they had completed spawning on the lower lakes and were engaged in spawning on the upper ones.

No explanations can be given for the dolly varden's significant changes in ratio on Placid and Inez, nor for the significant change in whitefish ratios from Alva. It must be remembered that at the 95% confidence level at which these ratios are compared, there will be approximately 5 times out of 100 that variations greater than these may occur through chance. With 106 individual samples represented on Table 2, it is to be expected a few of the differences shown to be significant, may actually be due to sampling error.

As the main purpose of this job was to obtain population indices, which will be used to evaluate various types of cutthroat trout management on these lakes, it is well to note that no significant changes in ratio were shown for this species.

Recommendations:

The catch ratios which have been obtained by this job and its last year's counterpart have shown no significant changes for cutthroat trout between two consecutive years' samples. Therefore, it is recommended that these ratios be used as a basis for the future evaluation of the cutthroat trout management measures which are now in use on some of the Clearwater lakes.

In some cases, these catch ratios have shown significant variation between the two consecutive years' samples for certain species of fish other than cutthroat. However, most of these changes may be plausibly justified by our knowledge of fish activity related to time of sampling. In order to gain more information concerning these significant changes in ratios and the validity of our proposed reasons for their occurrance, it is recommended that this netting job be repeated yearly until the success or failure of the various present cutthroat trout management practices are indicated.

A total of four years from the inception of the present management practices should be a sufficient length of time for any particular type of management to affect the cutthroat trout catch ratio, provided that any of the measures which are now in use are effective. As the present management program (the one of varied degrees and types of effort on different lakes) was started partially in 1954 and completely in 1955, it is recommended that this job be repeated in the 1957 and 1958 seasons. It is also recommended that, in 1958-59, the entire four years' data be given statistical treatment similar to that given the two previous years' data in this report.

This analysis will then indicate the presence or absence of a true change in catch rate of cutthroat trout on each of the six lakes during the four years of sample. The continuation of any of the special management practices should then depend upon the relationship of this change on each of the lakes receiving special effort to the change on the lake receiving no special effort.

The following recommendations are made for the 1957 sampling:

1. The sampling should be scheduled for roughly the same time of year that the two previous years' samples were made.

2. Preliminary netting, to determine if deep water sets should be used in the regular sampling program, need not be repeated this year.

3. Individual net sets should be made at the same locations at which they were made in 1955 and 1956.

4. Maximum-minimum thermometer stations should be established in several of the lake outlets by mid-May. Readings should be recorded from these every two days until the netting job is completed.

5. Scale samples need be taken only from those species upon which a special life history study is being made, or from those species for which additional samples are required for better growth rate analysis of present collections.

Summary:

1. A comparison of deep to shallow water sets made in two of the Clearwater lakes just prior to the regular netting schedule showed that shallow water sets captured more fish of the same kinds than did deep water sets. Therefore, shallow sets only were used in the regular netting schedule. From June 17-22, six two-man crews made five overnight sets in the six main Clearwater lakes. The following number of 125 foot nylon experimental gill nets were used in each lake: Salmon - 4, Seeley - 5, Placid - 5, Inez - 4, Alva - 4, and Rainy - 2. Maps showing the locations of the 1955 net sets were furnished to each crew and each individual net set was made at the location shown for that set in 1955. The crew on each lake was composed of at least one individual who had worked on that particular lake in 1955.

2. All fish captured were weighed, measured and recorded. Scale samples were taken in general only from the squawfish and Columbia River chub and from other species only where additional samples were required to fill out the 1955 collections. Scale analysis has not been completed for this year, consequently, the revision of the 1955 age and growth data is not included in this report.

3. The total catch of all species by lakes and the total number of net sets made in each lake are shown in Table 2. For comparison, these data are also included from the 1955 sampling in Table 3. The average catch of fish per net set (catch ratio) for both years'

samples, by species and by lakes is given in Table 4 for the 9 species of fish which were most numerous in both years' catches. The fiducial intervals at the 95% confidence level of these catch ratios are also included in this table. The significance of the changes in ratio, which are shown on Table 4, are summarized on Table 5. They are shown here as a significant increase, a significant decrease, or no significant change.

4. Significant increases in ratio are shown chiefly for both species of suckers, for the yellow perch and for the pumpkinseed sunfish. These changes are believed to be due either to an increase in fish numbers, or to an increase in fish activity with a later sampling date in 1956. Significant decreases in ratio are limited primarily to the Columbia River chub on two lakes. It is believed that these could be due to the spawning period of these fish as related to the time of sampling.

5. Because no significant changes between the two years' sample were indicated for the cutthroat catch ratios, it is recommended that these data be used as a basis for future evaluation of different management practices in use on the various lakes.

6. In order to gain more information concerning the significant changes in catch ratio of some of the other species and the validity of our proposed reasons for their occurrance, it is recommended that this netting job be repeated yearly until the data required for the cutthroat trout management evaluation are obtained.

7. The cutthroat trout management practices mentioned above were initiated in 1954 and 1955. Four years' time should be sufficient to allow any effective management practice to affect the catch ratio of the cutthroat trout. Therefore, it is recommended that this job be repeated in 1957 and 1958.

8. It is also recommended that in 1958-59, the four years' data be given statistical treatment similar to that used on the data in this report. The evaluation of the management practice in use on any particular lake will then depend upon the relationship of the change in cutthroat trout catch ratio on that lake to the change in ratio on the lake receiving no special management effort.

9. The following recommendations are made for 1957 sampling:

a. The netting should be scheduled for the first part of June.
b. The preliminary netting should not be repeated this year.
c. Net sets should be made at the same locations at which they were made in 1955 and 1956.
d. Maximum-minimum thermometer stations should be established in several of the lake outlets by mid-May.
e. Scale samples should be taken only from those fish for which additional data is required for good age and growth analysis of present samples.

Data and Reports:

The original data and reports are with the project leader in Missoula. All field scale data, scale mounts and copies of the age and growth data are at the Department's fishery laboratory at Bozeman, Montana

Literature cited:

Snedecore, George W., 1946
Statistical methods. Iowa State College Press, Ames, Iowa. xvi, 485 pp.

Prepared by Arthur N. Whitney

Approved by George D. Holton
GEORGE D. HOLTON

Date April 15, 1957

TABLE I

Comparison of Deep to Shallow Sets in Seeley and Placid Lakes
Preliminary Netting 1956

Lake	No. & Size of Nets	Depth of Set	CT	DV	KOK	EB	WF	SQ	CRC	FSu	CSu	YP	PS	TOTAL
PLACID	1 - 250'	70' - 70'	0	0	0	0	0	0	0	1	0	0	0	1
	2 - 125'	8' - 25' 6' - 12'	5	0	0	2	20	9	29	27	4	0	44	140
SEELEY	1 - 250'	100' - 100'	0	0	0	0	0	0	0	0	0	0	0	0
	2 - 125'	10' - 22' 10' - 20'	0	3	1	0	30	8	1	4	0	12	0	57

TABLE II

125-FOOT OVERNIGHT NET SETS
CLEARWATER LAKES, JUNE 17-22, 1956

TOTAL CATCHES BY NUMBERS OF SPECIES

Lake	No. of Sets	CT	EB	RB	DV	LL	KOK	WF	SQ	CRC	SQ X CRC	FSu	CSu	YP	PS	RSH	LMB	TOTAL
Salmon	20	4	0	1	3	2	2	81	164	71	0	96	86	760	15	0	1	1286
Seeley	25	19	0	0	30	0	1	148	174	71	0	92	101	415	59	0	2	1112
Placid	25	19	5	0	9	0	4	181	34	151	0	69	24	0	237	0	0	733
Inez	20	0	0	0	13	0	3	146	83	28	0	23	49	190	2	0	0	537
Alva	20	2	0	0	17	0	0	100	197	28	0	91	51	31	0	0	0	517
Rainy	10	5	0	0	12	0	0	106	52	49	1	45	27	56	0	1	0	354
TOTAL	120	49	5	1	84	2	10	762	704	398	1	416	338	1452	313	1	3	4539

TABLE III

125-FOOT OVERNIGHT NET SETS
CLEARWATER LAKES, JUNE 5-10, 1955

TOTAL CATCHES BY NUMBERS OF SPECIES

Lake	No. of Sets	CT	EB	RB	CT x RB	DV	KOK	WF	SQ	CRC	FSu	CSu	YP	PS	RSh	LMB	Total
Salmon	20	1	0	0	0	7	0	52	170	110	56	49	323	5	2	0	775
Seeley	25	23	0	2	0	35	21	111	185	276	56	37	85	35	1	0	867
Placid	25	5	14	0	0	23	6	178	49	298	37	9	0	34	0	1	654
Inez	15	2	0	0	1	4	3	104	90	14	43	6	25	0	0	0	292
Alva	16	7	0	0	0	9	0	45	83	12	35	8	4	0	0	0	203
Rainy	9	5	0	0	0	8	1	84	49	23	33	21	8	0	0	0	232
Total	110	43	14	2	1	86	31	574	626	733	260	130	445	74	3	1	3023

TABLE IV

Average Catch Per Net Set and Fiducial Intervals at the 95% Confidence Level

LAKE	YEAR	CT	DV	WF	SQ	CRC	FSu	CSu	YP	PS
SALMON	1955	0.1 (0.0-0.2)	0.4 (0.1-0.7)	2.6 (1.0-4.2)	8.5 (4.7-12.3)	5.5 (2.1-8.9)	2.8 (1.4-4.4)	2.5 (0.5-4.5)	16.2 (8.0-24.4)	0.3 (0.1-0.5)
	1956	0.2 (0.0-0.4)	0.2 (0.0-0.4)	4.1 (1.8-6.4)	8.2 (2.6-13.8)	3.6 (1.6-5.6)	4.8 (2.0-7.6)	4.3 (2.1-6.5)	38.0 (16.8-59.2)	0.8 (0.0-1.6)
SEELEY	1955	0.9 (0.5-1.3)	1.4 (0.7-2.1)	4.4 (2.8-6.0)	7.4 (5.6-9.2)	11.0 (8.2-13.8)	2.2 (1.3-3.1)	1.5 (0.9-2.1)	3.4 (1.7-5.1)	1.4 (0.5-2.3)
	1956	0.8 (0.2-1.4)	1.2 (0.6-1.8)	5.9 (3.4-8.4)	7.0 (6.1-7.9)	2.8 (1.4-4.2)	3.7 (2.7-4.7)	4.0 (3.3-4.7)	16.6 (8.8-24.4)	2.4 (1.8-3.0)
PLACID	1955	0.2 (0.0-0.4)	0.9 (0.6-2.2)	7.1 (5.0-9.4)	2.0 (1.3-2.7)	11.9 (7.2-16.6)	1.5 (0.6-2.4)	0.4 (0.9-2.1)	NONE	1.4 (0.4-2.4)
	1956	0.8 (0.2-1.4)	0.4 (0.2-0.6)	7.2 (5.2-9.2)	1.4 (0.4-2.4)	6.0 (2.5-9.5)	2.8 (0.5-5.1)	1.0 (0.4-1.6)	NONE	9.5 (2.9-16.1)
INEZ	1955	0.1 (0.0-0.3)	0.3 (0.0-0.6)	6.9 (3.9-9.9)	6.0 (3.2-8.6)	0.9 (0.2-1.6)	2.9 (0.4-5.4)	0.4 (0.0-0.8)	1.7 (0.2-3.2)	NONE
	1956	NONE	0.7 (0.4-1.0)	7.3 (4.0-10.6)	4.2 (1.9-6.5)	1.4 (0.4-2.4)	1.2 (0.2-2.2)	2.5 (0.6-4.4)	9.5 (3.2-15.8)	0.1 (0.0-0.3)
ALVA	1955	0.4 (0.0-0.9)	0.6 (0.2-1.0)	2.8 (1.0-4.6)	5.2 (3.0-7.4)	0.8 (0.1-1.5)	2.2 (1.1-3.3)	0.5 (0.1-0.9)	0.3 (0.0-0.7)	NONE
	1956	0.1 (0.0-0.3)	0.9 (0.5-1.3)	5.0 (3.3-6.7)	9.9 (4.7-15.1)	1.4 (0.4-2.4)	4.6 (2.7-6.5)	2.6 (0.3-4.9)	1.6 (0.8-2.4)	NONE
RAINY	1955	0.6 (0.0-1.3)	0.9 (0.0-1.8)	9.3 (5.2-13.4)	5.4 (2.4-8.4)	2.6 (0.4-4.8)	3.7 (1.3-6.1)	2.3 (0.4-4.2)	0.9 (0.2-1.6)	NONE
	1956	0.5 (0.0-1.0)	1.2 (0.1-2.3)	10.6 (8.1-13.1)	5.2 (1.6-8.8)	4.9 (0.0-10.1)	4.5 (1.6-7.4)	2.7 (0.7-4.7)	5.6 (0.0-15.6)	NONE

TABLE NO. V

Direction of Significant Change in Average Catch per Net from 1955 to 1956 at the 95% Confidence Level. (+) = significant increase, (-) = significant decrease, (o) = no significant change, (*) = no fish taken in either year's sample.

LAKE	SPECIES								
	CT	DV	WF	SQ	CRC	FSu	CSu	YP	PS
SALMON	o	o	o	o	o	o	o	+	o
SEELEY	o	o	o	o	-	+	+	+	+
PLACID	o	-	o	o	-	o	o	*	+
INEZ	o	+	o	o	o	o	+	+	o
ALVA	o	o	+	o	o	+	o	+	*
RAINY	o	o	o	o	o	o	o	o	*

MONTANA STATE DEPARTMENT OF FISH AND GAME
FEDERAL AID IN FISH RESTORATION SECTION
HELENA, MONTANA

JOB COMPLETION REPORT
INVESTIGATIONS PROJECTS

26
#6

State of Montana

Project No. F-12-R-3

Name Western Montana Fishery Study

Job. No. I

Title Inventory of the Waters of the Project Area

Period Covered May 1, 1956 to April 30, 1957

Abstract:

Eighteen lakes in the Blackfoot drainage were mapped from aerial photos. The maps are to be used in sounding operations on these lakes the next field season.

Survey information was taken on two lakes, one reservoir, two rivers and eighteen smaller streams in the project area. The numbers and kinds of fish collected, along with some other survey data, are included in this report.

Recommendations for management practices and further surveys are given.

Objectives:

The object of this project is to determine thephysical, chemical, and biological characteristics of the waters of highest importance to the total recreational fisheries picture of the project area, and where practicable, to obtain estimates of existing or potential fisherman use.

Techniques Used:

Aerial photographs were taken of 18 lakes in the Blackfoot drainage and large scale maps have been prepared from these photos. Three of these lakes were checked by ground survey and their fish populations were sampled by the use of gill nets.

The fish population of the Big Blackfoot River was sampled by the percussion method at seven stations. These stations were located between the proposed damsite and the general vicinity of the town of Lincoln. This is a distance of approximately 65 river miles.

Eighteen tributaries of the above mentioned section of the Big Blackfoot River were checked by ground survey. The fish populations in 12 of these streams were sampled by electro-fishing. The other six streams were either dry, or of insufficient size to sample. On Monture Creek, four-300 foot sections were chosen for ease of access and apparent productivity. These sections were measured, divided into 150 foot sub-sections and blocked off with nets. The catch was recorded separately by sub-section. Only one section was chosen on each of the other 11 streams. Block nets were not used and the estimated length of the sections varied from 100 to 300 feet.

Twelve-300 foot sections of the Little Blackfoot River were sampled by electro-fishing. These sections were located roughly every two miles between the River's mouth and the general vicinity of the town of Elliston. Productive looking parts of the river were picked for sample sections in an effort to obtain as large a fish sample as possible. Each 300 foot section was blocked off with nets and was treated as two-150 foot sub-sections.

Except as noted under Findings, all fish captured during each of the above surveys were weighed, measured and recorded. Scale samples were taken from species for which age and growth data was desired. In general, the standard lake or stream survey cards were filled out for all waters which were checked by ground surveys.

Findings:

Eight overnight sets with 125 foot experimental gill nets and two overnight sets with a 30 foot by 5/16 inch mesh gill net were made in Marshall Lake from July 11 through July 13, 1956. Two cutthroat trout, 11 dolly varden trout, 147 mountain whitefish, 50 suckers and three long-nosed dace were captured. The maximum depth of the lake was found to be 55 feet and the secchi disc reading was 25 feet.

Four overnight sets with 125 foot experimental gill nets were made in Summitt Lake from July 20 to July 22, 1956. Twenty-five cutthroat trout, one dolly varden trout, one mountain whitefish, 1 Columbia River chub, 14 squawfish, 111 suckers and 338 yellow perch were captured. The maximum depth of the lake was 11 feet, and the entire lake bottom was covered with dense beds of *Ceratophyllum* and *Myriophyllum*. The surface temperature was 74° at the time of the survey.

On August 25-26, 1956, four overnight sets with 125 foot experimental gill nets were made in Nevada Creek Reservoir. The following fish were captured: 18 rainbow trout, 1 cutthroat trout, 4 cutthroat-rainbow hybrids, 1 brown trout, 1 mountain whitefish, 21 red-sided shiners and 950 suckers. Only game fish were weighted and measured from this catch -- other species were counted and tallied.

From August 9 through August 17, 1956, seven stations on the Big Blackfoot River were sampled by the percussion method. These seven stations extended over a distance of about 65 river miles above the proposed Ninemile Prairie damsite. The following fish were taken: one cutthroat trout, one dolly varden trout, 10 rainbow trout, 14 brown trout, 324 mountain whitefish, 11 squawfish and 60 suckers.

From September 17 through October 5, 1956, twelve streams tributary to the above mentioned section of the Big Blackfoot River were sampled by electro-fishing. Following is a list of the names of the streams which were sampled, and numbers and kinds of fish captured from each: Monture Creek - 33 eastern brook trout, 50 rainbow trout, six dolly varden trout, nine mountain whitefish and cottus too numerous to count; North Fork of the Blackfoot River - two rainbow-cutthroat hybrids, three mountain whitefish and one dolly varden trout; Nevada Creek - five rainbow trout, one cutthroat trout, four rainbow-cutthroat hybrids, three brown trout, two mountain whitefish, 74 red-sided shiners, 32 long-nosed dace and 66 suckers; Cottonwood Creek (near Helmville) - three cutthroat; Wales Creek-25 cutthroat trout, one rainbow trout and one rainbow-cutthroat hybrid; Douglas Creek - 29 cutthroat trout, 20 mountain whitefish, 12 suckers and 14 long-nosed dace; Yourname Creek - 19 cutthroat trout; Pearson Creek - 20 cutthroat trout; Chamberlain Creek - 45 Cutthroat trout; Cottonwood Creek (near Ovando) - six rainbow-cutthroat hybrids, four mountain whitefish and one sucker; Elk Creek - eight cutthroat trout, four rainbow trout, three rainbow-cutthroat hybrids and three eastern brook trout; Blanchard Creek - 147 rainbow trout, 49 rainbow-cutthroat hybrids, three cutthroat trout and three eastern brook trout.

The primary purpose of all the above listed surveys was to determine the extent of the squawfish, Columbia River chub and yellow perch ranges in the Big Blackfoot drainage. However, regular survey information was recorded on Montana's standard forms and this will be added to the general lake and stream survey file. Because the Job III completion report concerned only the phases of these surveys which were concerned with squawfish and Columbia River chub ranges, the other aspects have been reported here.

From August 20 through August 24, 1956, twelve sections of the Little Blackfoot River were sampled by electro-fishing. The following numbers of fish were taken: 924 brown trout, 965 mountain whitefish, 50 cutthroat trout, 22 eastern brook trout, two rainbow trout, 48 suckers and 77 long-nosed dace. At the time of the survey, the river was found to be extremely low due to irrigation de-watering throughout the entire length of the section. Survey information recorded on electro-fishing forms is being transferred to standard stream survey file cards.

Recommendations:

Marshall Lake need not be considered in a rehabilitation project designed to remove squawfish, Columbia River chub and yellow perch from the Blackfoot drainage.

Due to low numbers of trout and an absence of other predacious fish in the catch, Marshall Lake should afford one of the best natural habitats in the Clearwater drainage for the survival of cutthroat fingerling plants. It is recommended that an annual plant of 9-10,000 cutthroat fingerlings be made in this lake for the next four years. At the end of that time the lake should be surveyed again to determine if there has been any increase in the cutthroat catch rate.

Because Summit Lake was found to contain squawfish, chub and yellow perch, it must be included in the Blackfoot drainage rehabilitation plans.

Although Nevada Creek Reservoir was found to contain no squawfish, chub or perch, the catch rate of suckers was found to be extremely high. The drainage above the dam is small and the dam itself forms an effective block to upstream fish movement. The ranges of the suckers and red-sided shiners above the reservoir should be checked in 1957 to determine the feasibility of rehabilitating this small drainage.

Percussion sampling should be continued in the upper portion of the main Big Blackfoot drainage in order to more accurately define the upper limits of the squawfish range.

Only 13 of the 89 trout taken from the four sections of Monture Creek were over seven inches long. As the area sampled consisted of 1200 feet of some of the most productive looking sections of the river, this indicates that the trout population present could contribute very little to angler success. Therefore, it is recommended that Monture Creek receive a yearly plant of catchable sized rainbow trout.

In most areas in Montana, the range of the native, west slope variety of cutthroat trout appears to be steadily decreasing. Efforts to maintain fishable populations of this species have been largely unsuccessful, except in very limited areas. The reduction in numbers of this fish is believed to be due to an increase in fishing pressure and to competition from exotic species, which have been introduced. According to early reports, this native cutthroat comprised the bulk of the early trout catches from the Blackfoot drainage. Now, after repeated plantings of many exotic species, the bulk of the trout catch is rainbow. Eastern brook and brown trout are known to occur in the area. In spite of this, the only trout collected from Douglas, Cottonwood (near Helmville), Yourname, Pearson and Chamberlain Creeks were of the native west slope cutthroat variety. These fish showed no apparent sign of hybridization with rainbow.

Because the native cutthroat has survived to the present time in these five streams without apparent contamination from other trout species or strains, it is recommended that the waters be considered as refuges for this disappearing species of fish. No plantings of any other type of fish should be made in these five streams. If later samples indicate that the numbers of these fish are decreasing in this area, then more stringent seasons and/or limits should be applied.

Sample stations were dispersed roughly one every two miles throughout approximately the lower half of the Little Blackfoot River. This part of the river has long been noted for its brown trout fishing, and the statewide creel census has indicated a catch for this species of about two fish per hour. Through 1955 this river section received a large yearly plant of brown trout fry and fingerlings. (In 1953, a fairly typical year, the plant consisted of 10,000 one inch, 16,000 two inch and 8,000 four inch brown trout). Brown trout in Montana's streams have, in most cases, been found capable of maintaining their populations without the aid of stocking and, in many instances, even in the face of stocking another species. Therefore, the General Fish Stocking and Management Policy, which was adopted in 1954, prohibited the general planting of this species in Montana streams and limited their production to one or two hatcheries east of the continental divide. Because the excellent brown trout catch rate of two fish per hour is unusual for this species, it was decided that it would be well to obtain population indices for brown trout in this stream both prior to, and sometime after, the ceasing of the plants.

Plants were continued (although somewhat reduced from earlier levels) through 1955, and ceased in 1956, the year of this sample. However, the fry and fingerling which were planted in any particular year would have to have attained at least one year's growth before entering the catch. Therefore, this first sample is considered a valid "while planted" inventory, even though it was made one year after the planting was discontinued.

It is recommended that this inventory be repeated yearly in 1957, 1958 and 1959. The brown trout catch per section for each year's sample should be analyzed statistically. The value (or lack of it) of the plants in sustaining the brown trout population could then be demonstrated by the presence or absence of a significant downward trend in the average brown trout catch per section from year to year.

Summary:

1. Maps of 18 lakes in the Blackfoot drainage have been prepared from aerial photographs. These will be used for sounding operations on the lakes this next field season.

2. Marshall Lake, Summit Lake and Nevada Creek Reservoir were surveyed in 1956.

3. Squawfish, Columbia River chub and yellow perch were found in Summit Lake only. This lake must, therefore, be included in the Blackfoot rehabilitation program.

4. Marshall Lake was found to contain few trout and no other predacious species. It is recommended that it be planted with cutthroat trout fingerlings.

5. Nevada Creek Reservoir was found to contain a high population of suckers. It is recommended that the small drainage above this reservoir be surveyed to determine the feasibility of a separate rehabilitation project on it.

6. Percussion sampling in the main Blackfoot River indicated that the squawfish range extended approximately 65 river miles above the proposed Ninemile Prairie damsite. It is recommended that this sampling be continued to more accurately define the upper limits of the squawfish range.

7. Eighteen streams, tributary to the section of the Big Blackfoot River within the range of the squawfish, were checked by ground survey. No squawfish were taken in any of these streams.

8. One of these tributary streams, Monture Creek, was found to contain a very poor population of catchable sized trout. It is recommended that this stream be put on the general planting program.

9. Five of the tributary streams (Douglas, Cottonwood, Yourname, Pearson and Chamberlain Creeks) were found to contain the native west slope variety of cutthroat as the only trout. It is recommended that no fish of any other variety be planted in these streams, and that later checks be made on these native populations. If the numbers of these fish ever become seriously reduced, it is recommended that the season be shortened and/or the limit be lowered on these waters.

10. Twelve-300 foot sections on the lower half of the Little Blackfoot River were sampled in 1956. This was the first year after the ceasing of brown trout planting in this stream. It is recommended that this sampling be repeated during the next three years.

11. Survey information was recorded on field forms and is being transferred to survey cards for inclusion in the district and state lake and stream survey files.

Data and Reports:

The original data and reports are with the project leader in Missoula. Material is being transferred to Montana's standard lake and stream survey cards, duplicate copies of which will be filed in the Helena office.

Prepared by: Arthur N. Whitney

Date April 19, 1957

Approved by George D. Holton
GEORGE D. HOLTON

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JOB COMPLETION REPORT
INVESTIGATIONS PROJECTS

State of Montana

Project No. F-12-R-2 Job No. II-A

Title of Job: Comparisons of Fish Populations of Six Clearwater Lakes

Abstract:

The six main Clearwater Lakes were netted simultaneously by six survey crews on June 5-10, 1955. All crews followed the same daily schedule. All fish captured were counted, weighed and measured and scale samples were taken from up to fifty individuals of each species. Scale samples were mounted, aged and analyzed for rate of growth.

Comparison of lakes were made by catch per net night of species and by growth rates of species. Data is presented by fiducial intervals of catch per net night at the 80, 90 and 95 percent levels and of calculated lengths at each annulus formation at the 95 percent level.

Indications of daily and seasonal catch variations between lakes are shown to demonstrate the necessity of netting all the lakes at the same time in order to minimize these variations.

It is recommended that this job be repeated in 1956 and that small fish collections be made to aid in the age and growth analysis. It is further recommended that a life history study of the squawfish and Columbia River chub in this drainage be considered when funds and personnel permit.

Objectives:

To obtain the best possible figures on the present fish populations in the main Clearwater Lakes--Salmon, Seeley, Placid, Inez, Alva and Rainy--as a basis for the evaluation of future management measures on these lakes. Specifically, to obtain indices of relative abundance and rates of growth of the various species of fish in the Clearwater Lakes.

Techniques Used:

During the week of May 29-June 4, 1955, one crew made an overnight set in Salmon, Seeley, Placid, Inez and Alva Lakes using one 250-foot and two 125-foot nylon experimental gill nets in each lake. In each of the lakes the 250-foot net was set deep (over 50 feet) and the two 125-foot nets were set shallow (less than 35 feet). All fish captured were weighed and measured, and scale samples were taken from some of the least numerous species to add to those from the later collections. This catch data (presented in Table I) was used to determine the best areas in which to set during the regular netting and was not included with the data from the later netting.

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TABLE I

Comparison of Deep to Shallow Sets by Lake -- Preliminary Netting

Lake	No. & Size of Nets	Depth of Set	RB X CT	DV	EB	KOK	WF	SQ	CRC	FSu	CSu	YP	PS	Total Fish
Salmon	1 - 250'	55' - 55'	0	0	0	0	0	2	1	0	0	0	0	3
	2 - 125'	6' - 20' 6' - 35'	0	1	10	0	0	24	40	11	3	147	0	236
Seeley	1 - 250'	75' - 80'	0	0	0	0	0	1	0	0	0	0	0	1
	2 - 125'	20' - 25' 7' - 25'	0	1	0	0	3	21	11	0	4	5	0	45
Placid	1 - 250'	65' - 65'	0	2	0	0	0	0	3	0	0	0	0	5
	2 - 125'	8' - 15' 10' - 20'	0	2	1	2	17	7	33	5	0	0	1	68
Inez	1 - 250'	50' - 55'	0	0	0	0	5	1	0	0	0	0	0	6
	2 - 125'	18' - 23' 6' - 11'	0	0	0	3	9	21	12	1	3	9	2	60
Alva	1 - 250'	55' - 70'	0	0	0	0	0	3	0	0	0	0	0	3
	2 - 125'	6' - 29' 15' - 22'	1	1	0	0	10	8	22	3	0	1	0	46

It is apparent that at the time of year this netting was done, the shallow water sets consistently captured more fish of the same kinds than did the deep water sets. Therefore, the crews on the regular netting project were instructed to make shallow water sets only.

On June 5, six two-man crews assembled in the Seeley Lake area with netting equipment, and the first net sets were made before dark. Nets were lifted and re-set on June 6, 7, 8 and 9 and were lifted and removed on June 10. Pertinent data on each set was recorded on Montana's standard netting forms and the location of each set was marked on a large scale outline map of each lake. All nets used were of the nylon experimental type which consist of five equal sections of one and one-half, two, two and one-half, three and four inch stretch measure mesh. Twenty of the nets were 125 feet long and two were 250 feet. The following number and size of nets were used in each lake: Salmon, four 125-foot; Seeley, five 125-foot; Placid, five 125-foot; Inez, three, 125-foot and one 250-foot; Alva, three 125-foot and one 250-foot; Rainy, two 125-foot. The 250-foot nets were added to Alva and Inez in an attempt to gain some information on comparison of catches between the two sizes and to increase the size of the fish sample from the two lakes upon which the most differing management measures are expected to be applied.

The following daily schedule was used by all crews: Nets were lifted, all fish were worked, nets were mended when necessary and nets were re-set. All fish captured were counted, weighed and measured and scale samples were taken from up to fifty individuals of each species, except squawfish from which one hundred samples were taken. Fifty of the squawfish samples from each lake were sent to the U. S. Fish and Wildlife Service in Portland, and all other scale samples were mounted at the Department's fishery laboratory. Readable scales were aged and tabbed, and growth rates were calculated.

Findings:

Following is a list of abbreviations used on the tables in this report, common names and scientific names of the species of fish taken during the netting project:

Abbreviation	Common Name	Scientific Name
CT	Cutthroat trout	*Salmo clarkii*
EB	Eastern brook trout	*Salvelinus fontinalis*
RB	Rainbow trout	*Salmo gardnerii*
DV	Dolly Varden trout	*Salvelinus malma*
KOK	Kokanee	*Oncorhynchus nerka*
WF	Mountain whitefish	*Prosopium williamsoni*
SQ	Squawfish	*Ptychocheilus oregonensis*
CRC	Columbia River chub	*Mylocheilus caurinus*
FSu	Fine-scaled sucker	*Catostomus catostomus*
CSu	Coarse-scaled sucker	*Catostomus macrocheilus*
YP	Yellow perch	*Perca flavescens*
PS	Pumpkinseed sunfish	*Lepomis gibbosus*
RSh	Red-sided shiner	*Richardsonius balteatus*
LMB	Largemouth bass	*Micropterus salmoides*

Growth Rates

The calcualted length at each annulus formation and number of fish in each age group sample are shown by species on Tables II through XII. It is apparent that the sample size is not large enough for some species to warrant statistical analysis of all the growth data. For the species from which the sample size was in general over 30 for most lakes sigma and the plus and minus fiducial interval (by the procedure descibed on page 64, Snedecore, 1946) at the 95 percent level were computed through the age groups which had in general at least ten samples remaining. These species were squawfish, Columbia River chub, fine-scaled sucker, whitefish and yellow perch. In addition, the same analysis were applied to the growth rate of the Dolly Varden, the most numerous trout in the catch. These fiducial intervals are compared by lakes on Tables XIII through XVIII.

TABLE II

Cutthroat

Average Calculated Length at Each Annulus Formation and Number of Samples by Lake

Lake		I	II	III	IV	V
Salmon	No.	1	1	1	1	
	Av. L.	2.6	5.7	9.2	12.0	
Seeley	No.	22	22	22	13	
	Av. L.	2.4	4.7	8.9	11.4	
Placid	No.	5	5	5	5	2
	Av. L.	2.7	5.4	8.7	11.2	12.5
Inez	No.	4	4	4	1	
	Av. L.	2.6	5.4	7.6	9.5	
Alva	No.	8	8	7	5	
	Av. L.	2.7	5.7	8.6	12.3	
Rainy	No.	6	6	6	4	3
	Av. L.	2.4	4.9	8.2	10.0	12.2

TABLE III

Dolly Varden

Average Calculated Length at Each Annulus Formation and Number of Samples by Lake

Lake		I	II	III	IV	V	VI	VII
Salmon	No.	8	8	8	8	4	3	3
	Av. L.	2.5	4.7	6.9	9.5	13.7	18.4	21.7
Seeley	No.	35	35	35	31	14	2	
	Av. L.	3.0	5.6	8.5	11.4	14.3	18.5	
Placid	No.	25	25	25	25	15	2	1
	Av. L.	3.0	5.5	8.7	11.8	15.0	18.2	23.0
Inez	No.	14	14	14	13	7	2	
	Av. L.	3.0	5.7	8.1	10.8	13.3	16.2	
Alva	No.	12	12	12	12	4	1	
	Av. L.	2.7	5.3	7.8	10.7	13.2	16.5	
Rainy	No.	9	9	9	9	4	1	1
	Av. L.	2.7	5.1	7.9	10.9	13.7	19.0	22.0

TABLE IV

Kokanee

Average Calculated Length at Each Annulus Formation and Number of Samples by Lake

None Taken in Salmon, Alva and Rainy

Lake		I	II	III	IV
Seeley	No.	21	21	11	
	Av. L.	3.3	8.2	11.2	
Placid	No.	8	8	4	2
	Av. L.	2.8	6.8	9.3	10.7
Inez	No.	6	6	2	
	Av. L.	3.4	7.8	9.7	

TABLE V

Eastern Brook

Average Calculated Length at Each Annulus Formation and Number of Samples by Lake

Taken in Placid Only

Lake		I	II	III	IV	V
Placid	No.	15	15	15	13	6
	Av. L.	2.8	5.5	8.4	11.1	14.5

TABLE VI

Whitefish

Average Calculated Length at Each Annulus Formation and Number of Samples by Lake

Lake		I	II	III	IV	V	VI	VII
Salmon	No.	50	50	48	18	1		
	Av. L.	3.7	8.2	10.3	11.3	12.6		
Seeley	No.	47	47	45	19			
	Av. L.	3.4	7.6	9.9	10.8			
Placid	No.	52	52	42	26	5	2	
	Av. L.	4.0	7.8	9.5	10.8	12.3	13.3	
Inez	No.	48	48	35	13	1		
	Av. L.	3.6	7.2	9.0	9.9	11.5		
Alva	No.	54	54	46	30	10	1	1
	Av. L.	4.0	7.8	9.7	10.7	11.8	13.1	14.0
Rainy	No.	52	52	36	9			
	Av. L.	3.9	6.9	8.5	9.4			

TABLE VII

Squawfish

Average Calculated Length at Each Annulus Formation and Number of Samples by Lake

Lake		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV
Salmon	No.	49	49	49	49	49	44	20	8	3	3	1			
	Av. L.	1.8	3.3	4.7	6.2	7.4	8.7	10.0	12.5	15.7	17.4	20.4			
Seeley	No.	47	47	47	46	39	34	18	7	2	1	1			
	Av. L.	2.1	3.9	5.8	7.4	8.9	10.4	11.8	12.8	15.3	17.7	19.1			
Placid	No.	51	51	51	51	49	34	7	7	3	2	1			
	Av. L.	2.0	3.9	5.9	7.9	9.6	11.3	12.9	14.4	15.2	17.7	19.3			
Inez	No.	44	44	44	44	43	38	29	21	14	6	4	3		
	Av. L.	1.9	3.4	5.1	6.7	8.2	9.7	11.4	12.9	14.3	16.2	17.5	18.4		
Alva	No.	46	46	46	46	46	45	31	22	11	8	6	5	3	
	Av. L.	1.7	3.1	4.6	6.1	7.6	9.0	10.8	12.5	14.0	15.7	17.1	18.3	19.5	
Rainy	No.	52	52	52	52	52	51	46	15	8	5	3	2	1	1
	Av. L.	1.6	3.0	4.5	5.8	7.2	8.4	9.6	12.1	13.6	15.2	16.1	17.2	17.1	18.4

TABLE VIII

Columbia River Chub

Average Calculated Length at Each Annulus Formation and Number of Samples by Lake

Lake		I	II	III	IV	V	VI	VII	VIII	IX
Salmon	No.	50	50	50	48	43	18	4		
	Av. L.	2.5	4.6	6.6	8.3	9.6	10.9	11.9		
Seeley	No.	43	43	43	38	34	18	5		
	Av. L.	2.4	4.8	7.0	8.7	10.3	11.6	12.3		
Placid	No.	53	53	53	47	46	35	15	3	1
	Av. L.	2.4	4.5	6.5	8.2	9.6	10.8	12.0	13.0	13.8
Inez	No.	31	31	31	28	27	22	12	4	1
	Av. L.	2.3	4.5	6.6	8.5	9.9	11.3	12.3	13.2	13.5
Alva	No.	32	32	32	31	31	19	7		
	Av. L.	2.0	3.8	5.6	7.2	8.7	10.0	11.1		
Rainy	No.	34	34	34	34	34	27	9	1	
	Av. L.	2.0	3.7	5.5	7.2	8.7	10.0	11.1	12.6	

TABLE IX

Fine-scaled Sucker

Average Calculated Length at Each Annulus Formation and Number of Samples by Lake

Lake		I	II	III	IV	V	VI	VII	VIII
Salmon	No.	48	48	48	44	35	27	8	
	Av. L.	1.9	4.2	6.8	9.3	11.0	12.6	13.5	
Seeley	No.	50	50	49	47	40	30	14	1
	Av. L.	2.0	4.9	8.2	11.0	13.2	15.1	16.9	18.9
Placid	No.	39	39	39	38	35	19	6	
	Av. L.	1.9	5.0	8.7	11.9	14.0	15.6	16.8	
Inez	No.	45	45	45	19	14	9	3	
	Av. L.	1.6	4.4	7.5	9.6	12.0	13.9	15.2	
Alva	No.	43	43	43	40	35	31	24	13
	Av. L.	1.6	3.5	6.0	8.2	10.2	12.1	13.7	15.0
Rainy	No.	37	37	37	34	31	27	18	4
	Av. L.	1.6	3.5	5.7	8.0	10.0	11.9	13.1	14.3

TABLE X

Coarse-scaled Sucker

Average Calculated Length at Each Annulus Formation and Number of Samples by Lake

Lake		I	II	III	IV	V	VI	VII	VIII	IX
Salmon	No.	48	48	48	47	42	36	14	4	1
	Av. L.	1.8	3.8	6.0	8.0	9.8	11.4	12.8	16.7	17.0
Seeley	No.	41	41	41	38	33	24	16	10	2
	Av. L.	1.8	3.9	6.7	9.5	12.0	14.1	16.0	17.3	19.0
Placid	No.	9 samples taken 15.8" -- 21.2" T.L. not readable								
Inez	No.	20	20	20	17	15	11	6	2	
	Av. L.	1.7	3.6	6.1	8.2	10.2	12.1	14.2	16.7	
Alva	No.	10	10	10	10	10	6	5	2	
	Av. L.	1.7	3.6	5.5	7.8	9.7	11.1	13.3	16.7	
Rainy	No.	26	26	26	26	25	23	18	12	5
	Av. L.	1.6	3.3	5.2	7.1	9.0	10.8	12.8	14.2	15.7

TABLE XI

Yellow Perch

Average Calculated Length at Each Annulus Formation and Number of Samples by Lake

None Taken in Placid

Lake		I	II	III	IV	V	VI	VII	VIII	IX	X
Salmon	No.	51	51	51	51	43	34	6			
	Av. L.	1.6	3.3	4.4	5.3	5.8	6.2	6.7			
Seeley	No.	50	50	50	50	46	38	17	1		
	Av. L.	1.3	2.7	3.9	5.0	5.8	6.7	7.3	9.2		
Inez	No.	49	49	49	48	43	28	14			
	Av. L.	1.4	2.8	4.2	5.3	6.1	6.8	7.8			
Alva	No.	5	5	5	5	5	2	1	1	1	
	Av. L.	1.2	2.4	3.6	4.8	6.0	6.5	8.1	9.2	10.0	
Rainy	No.	9	9	9	9	9	8	3	3	2	1
	Av. L.	1.6	3.0	4.5	5.4	6.2	6.9	8.2	8.7	8.8	9.0

TABLE XII

Pumpkinseed Sunfish

Average Calculated Length at Each Annulus Formation and Number of Samples by Lake

None Taken in Alva and Rainy

Lake		I	II	III	IV	V	VI	VII	VIII	IX
Salmon	No.	4	4	4	4	4	2	1		
	Av. L.	1.0	2.2	3.3	4.3	5.4	5.4	5.8		
Seeley	No.	33	33	33	33	31	27	17	8	1
	Av. L.	0.9	2.0	3.3	4.7	5.7	6.4	6.8	7.2	7.3
Placid	No.	35	35	35	27	18	4			
	Av. L.	0.9	2.1	3.5	4.6	5.9	6.7			
Inez	No.	2	2	2	2	2	2	2	2	2
	Av. L.	1.2	2.5	3.7	4.7	5.5	6.0	6.4	6.8	7.2

TABLE XIII

Dolly Varden

Comparison by Lakes of Fiducial Intervals at 95% Level for Calculated Length at Each Annulus Formation

Lake	Annulus					
	I	II	III	IV	V	VI
Salmon	2.1-2.9	3.8-5.6	5.8-8.0	7.8-11.2	-- --	-- --
Seeley	2.8-3.2	5.3-5.9	8.1-8.6	10.8-12.0	13.2-15.4	-- --
Placid	2.8-3.2	5.2-5.8	8.3-9.1	11.3-12.3	14.3-15.7	-- --
Inez	2.8-3.2	5.5-5.9	7.7-8.5	10.1-11.5	-- --	-- --
Alva	2.4-3.0	4.8-5.8	7.4-8.2	10.0-11.4	-- --	-- --
Rainey	2.4-3.0	4.7-5.5	7.2-8.6	9.8-12.0	-- --	-- --

TABLE XIV

Squawfish

Comparison by Lakes of Fiducial Intervals at 95% Level for Calculated Length at Each Annulus Formation

Lake	Annulus							
	I	II	III	IV	V	VI	VII	VIII
Salmon	1.7-1.9	3.2-3.4	4.5-4.9	6.0-6.4	7.2-7.6	8.5-9.0	9.3-10.7	-- --
Seeley	2.0-2.2	3.8-4.0	5.6-6.0	7.2-7.6	8.7-9.1	10.1-10.7	11.3-12.3	-- --
Placid	1.9-2.1	3.8-4.0	5.7-6.1	7.7-8.1	9.5-9.7	11.1-11.5	-- --	-- --
Inez	1.8-2.0	3.3-3.5	4.9-5.3	6.5-6.9	8.0-8.4	9.4-10.0	11.1-11.7	12.5-13.3
Alva	1.6-1.8	3.0-3.2	4.5-4.7	5.9-6.3	7.4-7.8	8.8-9.2	10.5-11.1	12.2-12.8
Rainy	1.5-1.7	2.9-3.1	4.4-4.6	5.6-6.0	7.0-7.4	8.2-8.6	9.3-9.9	11.7-12.5

TABLE XV

Columbia River Chub

Comparison by Lakes of Fiducial Intervals at 85% Level for Calculated Length at Each Annulus Formation

Lake	Annulus					
	I	II	III	IV	V	VI
Salmon	2.4-2.6	4.5-4.7	6.4-6.8	8.1-8.5	9.4-9.8	10.6-11.2
Seeley	2.3-2.5	4.7-4.9	6.9-7.1	8.6-8.8	10.1-10.5	11.3-11.9
Placid	2.3-2.5	4.4-4.6	6.4-6.6	8.0-8.4	9.5-9.7	10.6-11.0
Inez	2.2-2.4	4.3-4.7	6.3-6.9	8.2-8.8	9.6-10.2	11.0-11.6
Alva	1.9-2.1	3.6-4.0	5.4-5.8	7.0-7.4	8.5-8.9	9.7-10.3
Rainy	1.9-2.1	3.6-3.8	5.3-5.7	7.0-7.4	8.5-8.9	9.7-10.3

TABLE XVI

Fine-scaled Sucker

Comparison by Lakes of Fiducial Intervals at 95% Level for Calculated Length at Each Annulus Formation

Lake	Annulus						
	I	II	III	IV	V	VI	VII
Salmon	1.8-2.0	4.0-4.4	6.5-7.1	9.0-9.6	10.7-11.3	12.2-13.0	-- --
Seeley	1.9-2.1	4.6-5.2	7.8-8.6	10.6-11.4	12.7-13.7	14.6-15.6	16.2-17.6
Placid	1.8-2.0	4.8-5.2	8.3-9.1	11.5-12.3	13.6-14.4	15.1-16.1	-- --
Inez	1.5-1.7	4.2-4.6	7.3-7.7	9.1-10.1	11.5-12.5	13.1-14.7	-- --
Alva	1.5-1.7	3.3-3.7	5.7-6.3	7.8-8.6	9.8-10.6	11.7-12.5	13.2-14.2
Rainy	1.5-1.7	3.3-3.7	5.5-5.9	7.8-8.2	9.7-10.3	11.6-12.2	12.9-13.3

TABLE XVII

Whitefish

Comparison by Lakes of Fiducial Intervals at 95% Level for Calculated Length at Each Annulus Formation

Lake	Annulus			
	I	II	III	IV
Salmon	3.6-3.8	8.0-8.4	10.1-10.5	11.0-11.6
Seeley	3.2-3.6	7.3-7.9	9.6-10.2	10.3-11.3
Placid	3.8-4.2	7.6-8.0	9.3- 9.7	10.5-11.1
Inez	3.4-3.8	7.0-7.4	8.8- 9.2	9.6-10.2
Alva	3.9-4.1	7.6-8.0	9.5- 9.9	10.4-11.0
Rainy	3.8-4.0	6.7-7.1	8.3- 8.7	8.8-10.0

TABLE XVIII

Yellow Perch

Comparison by Lakes of Fiducial Intervals at 95% Level for Calculated Length at Each Annulus Formation

Lake	Annulus						
	I	II	III	IV	V	VI	VII
Salmon	1.5-1.7	3.2-3.4	4.3-4.5	5.2-5.4	5.7-5.9	6.0-6.4	-- --
Seeley	1.2-1.4	2.6-2.9	3.7-4.1	4.8-5.2	5.6-6.0	6.4-7.0	6.9-7.7
Inez	1.3-1.5	2.7-2.9	4.1-4.3	5.1-5.5	5.9-6.3	6.4-7.2	7.1-8.5

Indices of Relative Abundance

The total catches by number of species and the numbers of 125-foot overnight net sets made are shown for each lake on Table XIX. From this data, the catch per net night was computed for the following species: Cutthroat trout, Dolly Varden trout, kokanee, mountain whitefish, squawfish, Columbia River chub, fine-scaled sucker, coarse-scaled sucker, yellow perch and pumpkinseed sunfish.

This is the average catch per overnight set with a 125-foot net. No consideration was given to the slight variations in the daily hours of set, because approximately the same daily schedule was followed on all lakes and all sets concerned were fished through the morning and evening periods. The plus and minus fiducial intervals at the 80, 90 and 95 percent levels of these catch figures are presented in Tables XX, XXI, and XXII, respectively. Because individual catches are extremely variable, and consequently, the fiducial intervals of the average catches are large, it is felt that comparisons should most likely be considered at the 80 percent probability level. This is the same level used by Moyle (1950) in comparison of Minnesota gill net catches.

TABLE XIX

125-FOOT OVERNIGHT NET SETS
CLEARWATER LAKES, JUNE 5-10, 1956

TOTAL CATCHES BY NUMBERS OF SPECIES

Lake	No. of Sets	CT	EB	RB	CT x RB	DV	KOK	WF	SQ	CRC	FSu	CSu	YP	PS	RSh	LMB	Total
Salmon	20	1	0	0	0	7	0	52	170	110	56	49	323	5	2	0	775
Seeley	25	23	0	2	0	35	21	111	185	276	56	37	85	35	1	0	867
Placid	25	5	14	0	0	23	6	178	49	298	37	9	0	34	0	1	654
Inez	15	2	0	0	1	4	3	104	90	14	43	6	25	0	0	0	292
Alva	16	7	0	0	0	9	0	45	83	12	35	8	4	0	0	0	203
Rainy	9	5	0	0	0	8	1	84	49	23	33	21	8	0	0	0	232
TOTAL		43	14	2	1	86	31	574	626	733	260	130	445	74	3	1	3023

TABLE XX

Comparison of Lakes of Fiducial Intervals at 80% Level for Catch Per Net Night by Numbers of Species

LAKE	CT	DV	KOK	WF	YP	PS	SQ	CRC	FSu	CSu
Salmon	0.0-0.2	0.2-0.6	-- --	1.6-3.6	11.0-21.4	0.1-0.5	6.1-10.9	3.3-7.7	1.9-3.9	1.2-3.8
Seeley	0.6-1.2	1.0-1.8	0.5-1.1	3.4-5.4	2.3-4.5	0.9-1.9	6.3-8.5	9.2-12.8	1.6-2.8	1.1-1.9
Placid	0.1-0.3	0.7-1.1	0.1-0.3	5.7-8.5	-- --	0.8-2.0	1.6-2.4	8.9-14.9	0.9-2.1	0.2-0.6
Inez	0.0-0.2	0.1-0.5	0.1-0.3	5.0-8.8	0.7-2.7	-- --	4.2-7.6	0.5-1.3	1.4-4.4	0.2-0.6
Alva	0.1-0.7	0.3-0.9	-- --	0.8-3.0	0.1-0.5	-- --	3.8-6.6	0.4-1.2	1.5-2.9	0.2-0.8
Rainy	0.2-1.0	0.4-1.4	0.0-0.3	6.8-11.8	0.5-1.3	-- --	3.6-7.2	1.2-4.0	2.3-5.1	1.2-3.4

TABLE XXI

Comparison by Lakes of Fiducial Intervals at 90% Level for Catch per Net Night by Numbers of Species

Lake	CT	DV	KOK	WF	YP	PS	SQ	CRC	FSu	CSu
Salmon	0.0-0.2	0.1-0.7	-- --	1.2-4.0	9.4-23.0	0.1-0.5	5.3-11.7	2.7-8.3	1.4-4.4	0.8-4.2
Seeley	0.5-1.4	0.8-2.0	0.4-1.2	3.0-5.8	2.0-4.8	0.7-2.1	5.9-8.9	8.7-13.3	1.5-2.9	1.0-2.0
Placid	0.1-0.3	0.6-1.2	0.1-0.3	5.3-9.1	-- --	0.6-2.2	1.4-2.6	8.0-15.8	0.8-2.2	0.1-0.7
Inez	0.0-0.3	0.0-0.6	0.1-0.5	4.4-9.4	1.4-3.0	-- --	3.9-8.1	0.4-1.4	0.9-4.9	0.1-0.7
Alva	0.0-0.8	0.2-1.0	-- --	1.3-4.3	0.0-0.6	-- --	3.4-7.0	0.2-1.4	1.3-3.1	0.1-0.9
Rainy	0.1-1.1	0.2-1.6	0.0-0.3	6.0-14.6	0.3-1.5	-- --	3.0-7.8	0.8-4.4	1.8-5.6	0.8-3.8

TABLE XXII

Comparison by Lakes of Fiducial Intervals at 95% Level for Catch per Net Night by Numbers of Species

Lake	CT	DV	KOK	WF	YP	PS	SQ	CRC	FSu	CSu
Salmon	0.0-0.2	0.1-0.7	-- --	1.0-4.2	8.0-24.4	0.1-0.5	4.7-12.3	2.1-8.9	1.4-4.4	0.5-4.5
Seeley	0.5-1.3	0.7-2.1	0.3-1.3	2.8-6.0	1.7-5.1	0.5-2.3	5.6-9.2	8.2-13.8	1.3-3.1	0.9-2.1
Placid	0.0-0.4	0.6-2.2	0.0-0.4	5.0-9.4	-- --	0.4-2.4	1.3-2.7	7.2-16.6	0.6-2.4	0.0-0.8
Inez	0.0-0.3	0.0-0.6	0.0-0.6	3.9-9.9	0.2-3.2	-- --	3.2-8.6	0.2-1.6	0.4-5.4	0.0-0.8
Alva	0.0-0.9	0.2-1.0	-- --	1.0-4.6	0.0-0.7	-- --	3.0-7.4	0.1-1.5	1.1-3.3	0.1-0.9
Rainy	0.0-1.3	0.0-1.8	0.0-0.4	5.2-13.4	0.2-1.6	-- --	2.4-8.4	0.4-4.8	1.3-6.1	0.4-4.2

Indications of Daily and Seasonal Catch Variations

Because this job was designed to equalize the effect of daily catch variations on all the lakes and to eliminate the effect of seasonal variations, an attempt was made to analyze the data to indicate such variations. This was done in order to demonstrate better the necessity of setting up this particular netting schedule to obtain the best comparative catch figures between the six lakes.

Figure 1 shows the percent of the total catch taken in each daily lift for each of the six lakes. It is realized that differences in relative locations between sets in different lakes might tend to mask any weather effect on the catch. However, note that while from the 6th through the 8th, no general trend is indicated, from the 8th to the 9th there was a decided decline in catch on all lakes, and from the 9th to the 10th there was a sharp increase in catch on four lakes, a lesser increase on one and a small decrease on only one.

Table 23 shows the percent rough and percent game fish in the catches of 1954 (from job completion report I-A, project F-12-R-1) and 1955, along with dates of survey. Note that in 1954, the two upper lakes (Alva and Inez), which were netted in July showed a higher percentage of game fish than did the three lower lakes, which were netted in June. Because this same grouping is not apparent in the 1955 catch, it is assumed that the 1954 differences were due more to the season of the year than to an actual difference in populations in the two groups of lakes.

It is felt that these indications of daily and seasonal catch variations amply indicate the need of a netting program as was used in 1955 to reduce the effect of such variations on comparative catch figures.

Recommendations:

A large number of individual comparisons between lakes are possible, both by growth rates and catch per net night of species. By themselves, these comparisons mean little at present to the management of the lakes. They will have value for management evaluation when this project is repeated in the future, and change (or lack of change) in the comparisons is noted. Therefore, it is not felt that a detailed discussion of these comparisons is necessary at this time.

Because it would be impossible to schedule this job for the same phenotypical time of year and the same kind of weather as was encountered in 1955, it is not intended to compare the same lakes in different years. Comparisons will be made on the basis of the relationship of one lake to the others in one year to that same relationship in a later year.

In order to evaluate better such comparisons, it is felt that it would be well to have two years' data at the outset. Therefore, it is recommended that this netting job be repeated in 1956 with the following changes:

1. Scale samples should be taken only from those species from which less than 50 samples were taken last year, to a total of 50 samples for both years. Samples where certain size groups are low or missing should be noted and crews informed so that needed size samples can be collected if they are encountered this year.

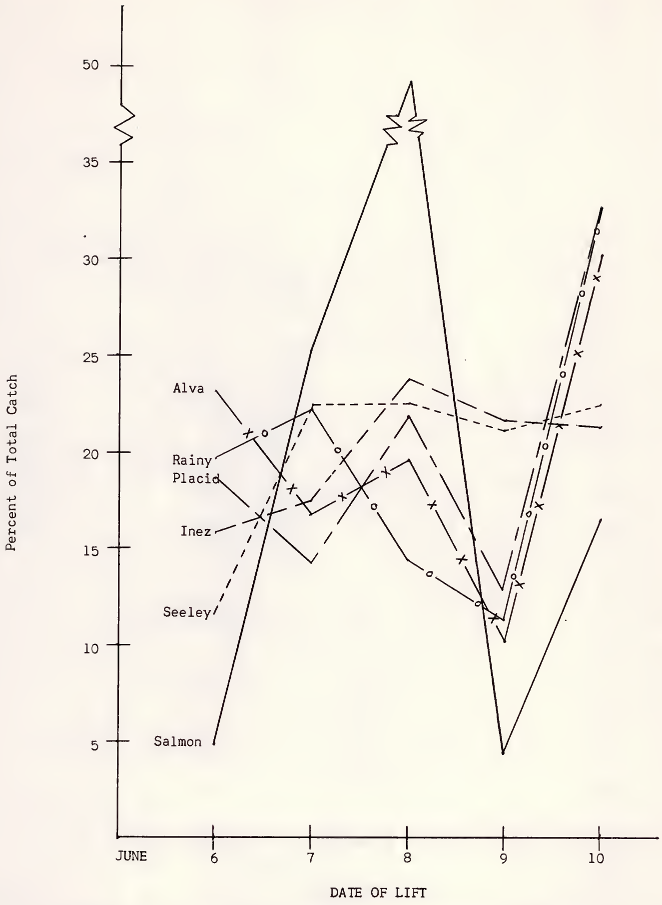

FIGURE NO. 1 -- Percent of Total Catch by Days of Lift on Each Lake

TABLE XXIII

Comparison by Lakes of the Percentage of Rough and Game Fish in the 1954 and 1955 Net Catches

Lake	1954				1955			
	No. of Sets	Date	% Rough Fish	% Game Fish	No. of Sets	Date	% Rough Fish	% Game Fish
Salmon	4	6/8,9	83.8	16.2	20	6/5,10	84.7	15.3
Seeley	3	6/10,11	84.2	15.8	25	6/5,10	81.3	18.7
Placid	3	6/9,10	85.2	14.8	25	6/5,10	70.3	29.7
Inez	3	7/8,9	54.8	45.2	15	6/5,10	76.9	23.1
Alva	4	3 on 7/9,10 1 on 11/14	50.8	49.2	16	6/5,10	77.0	23.0

2. Because several of the species concerned have little recorded on their growth rates and life histories, interpretations of scale markings was sometimes difficult. To aid in the growth analysis, small fish collections should be made either during the regular netting or by a special crew later in the season. Present scale readings should be re-evaluated after growth rates of small fish have been analyzed.

The two species most numerous in the catches from these lakes are the squawfish and the Columbia River chub. Therefore, if any partial or complete control measures are ever attempted in this drainage, they should probably be directed toward one or both of these fish. Very little information is available on either the squawfish or chub in general and practically nothing is available in this drainage. Therefore, it is apparent that information on their life histories, especially concerning their times and places of spawning, would be of value to the management of the fishery of this drainage. Such a study would be beyond the scope of this job, and because it would entail a full season or several season's work in just one part of the district, it should not be attempted by the project leader alone. However, it is recommended that when suitable assistance is available in the Western District, a life history study on these species in the Blackfoot drainage be set up.

Summary:

1. Comparison of deep to shallow sets made in five of the Clearwater Lakes just prior to the regular netting schedule showed that shallow sets took more fish of the same kinds than did the deep water sets. From June 5-10, six two-man crews made five overnight sets in the six main Clearwater Lakes. The following number of nets were used in each lake: Salmon, four 125-foot; Seeley, five 125-foot; Placid, five 125-foot; Inez, three 125-foot, and one 250-foot; Alva, three 125-foot, and one 250-foot; Rainy, two 125-foot. All crews were under the direction of fishery personnel familiar with lake survey methods and each crew followed the daily schedule of lifting

nets, working fish, mending nets when necessary, and re-setting nets. Sets progressed around the littoral zones of the lakes and their locations were marked on outline maps of the lakes.

2. All fish captured were counted, weighed and measured and scale samples were taken, in general, from up to fifty individuals of each species. All scale samples taken were mounted and all readable mounts were aged and tabbed for growth rate analysis. Three thousand twenty-three fish were taken in the 125-foot overnight sets. From these, 1,770 scale samples were taken and mounted, of which 1,692 samples were analyzed for age and rate of growth.

3. The total catch of all species and the average calculated lengths at annulus formation for all but the two rainbow, two redsided shiners and one rainbow-cutthroat hybrid are given by lakes in Tables II through XII and Table XIX. These data were summarized for comparison of lakes by catch per net night of cutthroat, Dolly Varden, kokanee, whitefish, yellow perch, pumpkinseed sunfish, squawfish, Columbia River chub, fine-scaled sucker and coarse-scaled sucker; and by average length at each annulus formation for Dolly Varden, whitefish, fine-scaled sucker, Columbia River chub, squawfish, and yellow perch. Fiducial intervals (obtained by the procedure described of page 64 in Snedecore, 1946) were computed at the 80,90 and 95 percent levels for catch per net night, and at the 95 percent level for average calculated length at annulus formation. These intervals are given in Tables XIII through XVIII and XX through XXII.

4. Indications of daily and seasonal variations in the catch were shown by the change in percent of daily catch on each day for each lake and by a comparison of the percent of game fish and percent of rough fish in the 1955 and 1956 catches respectively. These data are presented in Figure 1 and Table XXIII to demonstrate the need for the netting schedule used in this job.

5. The value of the comparisons of one lake to the others by the data presented here will be realized mainly in the future when this job is repeated and changes, or lack of changes in the relationships are noted. Therefore, such comparisons are not discussed in this report.

6. It is recommended that the job be repeated in 1956 with the following changes:

a. Scale samples should be taken only to a total of 50 samples for each species for both years or to supply samples from sizes of fish lacking in last year's scale collections.

b. Small fish collections should be made to aid in the growth analysis.

c. Present scale readings should be re-evaluated after growth rates of the small fish collections have been analyzed and all readings from both years' collections should be combined.

7. It is recommended that when funds and personnel permit, life history studies of the squawfish and Columbia River chub in this drainage be set up, with particular emphasis on time and place of spawning.

Data and Reports:

The original data and reports are with the project leader in Missoula. All field

scale data, scale mounts and duplicate copies of the age and growth data are at the Department's fishery laboratory at Bozeman.

<u>Literature Cited</u>:

Moyle, John B.
1950. Gill nets for sampling fish populations in Minnesota waters. Trans. Am. Fish. Soc., Vol. 79 (1949), pp. 195-204.

Snedecore, George W.
1946. Statistical methods. Iowa State College Press, Ames, Iowa. xvi + 485 pp.

Prepared by A. N. Whitney   Approved by Charles K. Phenicie

Date April 17, 1956

MONTANA STATE DEPARTMENT OF FISH AND GAME
FEDERAL AID IN FISH RESTORATION SECTION
HELENA, MONTANA

JOB COMPLETION REPORT
INVESTIGATIONS PROJECTS

26
#4

State of Montana

Project No. F-12-R-2 Job No. I-A

Title of Job: Inventory of the Waters of the Project Area

Abstract:

Time required for the Marias rehabilitation project limited the amount of survey work done under this project.

Eight lakes were surveyed with varying degrees of completeness. One stream census was abandoned and another planned census not attempted due to stream conditions which made quantitative sampling impossible.

Information of importance to the management of the waters surveyed is listed and management recommendations are given.

Objectives:

The purpose of this project is to determine the physical, chemical and biological characteristics of the waters of highest importance to the total recreational fisheries picture of the project area and where practicable to obtain estimates of existing or potential fisherman use.

Techniques Used:

Two and one-half months of the project leader's regular field season were spent on the Marias rehabilitation project under Project F-15-D-2. Consequently, survey work in the Western District (except for Job II-A -- Clearwater netting) was very limited.

Brown's Lake, Powell County, was netted, sketch mapped and water analysis was made by standard field methods. Harper's Lake, which was rehabilitated in 1954, was checked with net sets for completeness of kill and checked for turbidity, temperature and pH. A smaller unnamed lake, just north of Harpers, was sounded and found unsuitable for fish. Two small, land-locked lakes (Millpond and Tupper) in the Seeley Lake area were netted during the main Clearwater netting job. Echo Lake, Granite County, was netted to obtain a sample of the fish population, sketch mapped and partially sounded. During late winter and early spring, three small lakes (Millpond, Jones and Upsata) in the Seeley Lake-Ovando area were checked under snow and ice cover for dissolved oxygen content.

After the Marias project, an attempt was made to sample the fish population in the Little Blackfoot River in Lewis and Clark County. The large number of fallen and falling leaves at that time caused the block nets to plug and wash out so the job was abandoned after the second day. The upper Bitterroot was checked and the leaf condition found similar to that on the Little Blackfoot. Therefore, that census was not attempted.

Findings:

Fourteen overnight net sets (six floating and eight bottom) in Brown's Lake caught 171 fine-scaled suckers, 190 yellow perch, 9 silver salmon and two yellow pike perch. The salmon were taken in floating sets only. Temperatures between bottom and surface varied only slightly, from 18.0°C at the surface to 17.5°C at 20 feet, from June 22-27, 1955. pH was 8.6 and methyl purple alkalinity was 164 ppm.

Two overnight net sets produced nothing in Harper's Lake and no fishwere observed in shallow water. On July 2, the pH was between 8.4 and 9.0 and temperatures were 15.5°C at one foot and 13.0°C at 25 feet. The secchi disk was still visible on the bottom at 27.5 feet. This lake received an aerial plant of 30,000 grayling fry early in the season. None of these fish were observed throughout the summer and fall.

A small unnamed lake north of Harpers was found to have a heavy algal bloom on July 2, and to have a maximum depth of 12 feet.

Echo Lake was netted with 8 overnight sets -- 2 bottom and 6 floating. No fish were taken in the floating sets, while the bottom sets caught 75 rainbow trout, 1 rainbow-cutthroat hybrid, 6 eastern brook trout and 78 fine-scaled suckers.

Tupper and Millpond (two small, land-locked lakes in the Seeley Lake area) were netted with two overnight sets each during the main Clearwater netting program. Squawfish, Columbia River chub, suckers and yellow perch were taken in Millpond; nothing was taken in Tupper.

During late winter and early spring, Jones Lake was found to be completely devoid of oxygen and Upsata and Millpond varied between 1.6 and 2.3 ppm at the surface, under the ice.

In October, on the Little Blackfoot River, only one section was completely censused in two days shocking, without having the lower block net plug with leaves and wash out. The job was abandoned.

After the attempt on the Little Blackfoot, the Bitterroot streams which had been inventoried in 1952 and 1954 were checked and found also to contain large numbers of leaves. Because of this fact, inventories were not attempted.

Survey information is being transferred from field data to Montana standard lake and stream survey file cards.

Recommendations:

Brown's Lake has received silver salmon fingerling plants (made after dark) for the last two years. Even though there are large numbers of perch in the lake,

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some of the salmon from the 1954 plant showed up in the 1955 netting. Also, a few anglers have reported taking salmon during winter fishing this year. Therefore, it is recommended that the plants continue by the same method.

It is recommended that Harpers Lake be checked with small mesh gill nets (1/4" bar measure) and that if no grayling are taken that the lake not be replanted until some form of plankton life appears in it.

A local sportsmen's club proposed to fertilize Echo Lake at their own expense. It is a high (about 6,000 foot) mountain lake and showed an excellent catch of trout in the gill nets. Because trout of a desirable size are now present in the lake, and further, because the effect of fertilizers on winterkill cannot be predicted, it is recommended that this lake not be fertilized.

It is recommended that Millpond and Upsata Lakes be netted to determine if their present fish populations survived the low winter oxygen concentrations. The small, unnamed lake north of Harpers, Jones and Tupper Lakes should no longer be considered from a fishery standpoint.

For several years, the statewide creel census has showed a brown trout catch on the Little Blackfoot River of about two fish per hour; one of the best catch rates in the state for this species. Plants of brown trout, which had consisted of fry and fingerlings, were discontinued last year. It is recommended that population indices be obtained from this stream by the electric census method this summer and for at least two years following.

The first two censuses on the Bitterroot closed and open streams were not extensive enough to indicate population trends with any degree of accuracy. The job could not be done this year due to the Marias project. Therefore, it is recommended that the remaining closed streams in the area be opened to fishing and that this survey be discontinued.

Summary:

1. Survey work in the western district was very limited due to two and one-half months of the project leader's time being spent on the Marias rehabilitation.

2. Lakes surveyed and information taken on them were as follows:

Browns Lakes -- netting, sketch mapping, sounding and chemistry
Harpers Lake -- netting, turbidity and pH
Echo Lake -- netting and sketch mapping and some sounding
Millpond -- netting, sketch mapping, some sounding and winter oxygen concentration
Tupper -- netting
Jones and Upsata Lakes -- winter oxygen
One unnamed lake --- sounding.

3. In October, an electric fish census was attempted on the Little Blackfoot River and had to be abandoned because falling leaves kept plugging the block nets and causing them to wash out.

4. A census was planned on some of the upper Bitterroot streams but was not attempted because of falling leaf conditions, which were the same as on the Little Blackfoot.

5. The following recommendations were made, based on information gained under this survey project:

a. That silver salmon plants in Brown's Lake be continued;

b. That Harpers Lake be checked with 1/4" mesh gill nets and, if no fish are taken, that it not be replanted until plankton again appears in the lake;

c. That Echo Lake not be fertilized;

d. That Millpond and Upsata Lakes be netted to determine if the present fish populations survived the low winter oxygen concentrations;

e. That the unnamed lake, Jones, and Tupper Lakes no longer be considered from a fishery standpoint;

f. That a population inventory be made on the Little Blackfoot River this year and for two years following; and,

g. That the comparison of opened to closed streams in the Upper Bitterroot be discontinued and the closed streams be opened to fishing.

Data and Reports:

The original data and reports are with the project leader in Missoula. Material is being transferred to Montana's standard lake and stream survey cards, duplicate copies of which will be filed in the Helena office.

Prepared by A. N. Whitney Approved by Charles K. Phenicie

Date April 19, 1956

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JOB COMPLETION REPORT
INVESTIGATIONS PROJECTS

State of Montana

Project No. F-12-R-1 Job No. I-A

Title of Job: Cataloging the Waters of the Project Area

Comparison of Five Clearwater Lakes

Abstract:

Past management on the Clearwater Lakes has consisted of planting various species of fish and of rough fish removal by trapping. Rough fish removal has ceased, and planting continued. Previous plantings, while varying as to size and species in different years, did not, in general, vary from lake to lake on any plan, and there was no provision for checking their effectiveness. The planting program has been revised to concentrate the effort on cutthroat yearlings in one lake and on cutthroat fry in another. One sportsmen's club now proposes to do rough fish control on their own in a third lake. In order to evaluate the effectiveness of these measures, it is desirable that the best possible indices of relative abundance of the various species in these lakes be obtained at the present time.

Three overnight gill net sets were made in Lakes Placid, Seeley and Inez, and four were made in Lakes Salmon and Alva. The results of this netting are presented as total catch, catch per net night, and percent of total catch. Further comparison of the lakes is made by 1953 anglers' catch, percent game fish and percent rough fish, and times of survey. Because of manpower and equipment limitations, the netting done last year was not adequate for detailed population comparisons, and the time of survey varied widely in different lakes. The data presented are not tested for significance, but are analyzed chiefly from the aspect of setting up a netting plan for next year to minimize the limitations in the present data as much as possible. To eliminate the effect of seasonal and weather variations on catch rate, it is proposed to net all five of these lakes at the same time. Five netting crews will be used, and a number of requirements are proposed to insure uniformity of data collected.

The main value of the information gained will be as a basis for evaluating various management measures when the project is repeated in the future.

Objectives:

To catalog the waters of the project area from the standpoint of physical and chamical characteristics and from the standpoint of fish response to the environment. Specifically in this case, to gather indices of relative abundance of the various species in the fish populations of the five main Clearwater Lakes and to compare these lakes.

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Techniques Used:

Because manpower and equipment adequate for gill netting was not continuously available in this new district last year, the netting was done on the following schedule. On June 7-11, 1954, the project assistant and the lake survey equipment were borrowed from the Northwest District and the three larger lakes (Salmon, Placid and Seeley) were netted. One overnightset was made with four nets in Salmon on June 8; with three nets in Placid on June 9; and with three nets in Seeley on June 10. In July, a boat was borrowed from the Wildlife Restoration Division, a boat trailer from the Somers hatchery, and on July 8 and 9, 1954 the land survey crew assisted in netting the two smaller lakes (Alva and Inez). One overnight set was made with three nets in each lake, in Inez on July 8 and in Alva on July 9. One other overnight set was made in Alva on November 14, 1954.

All fish captured were counted, weighed, and measured and scale samples were taken from all trout, salmon, whitefish, perch and sunfish. Scale samples were sent to the Department's fishery laboratory for age and growth analysis. Time of set, time of lift and depth of set were noted and recorded along with information on catch on standard gill netting forms. Nets used were all 125-foot, experimental mesh, nylon gill nets, which are made up of five 25-foot sections of $1\frac{1}{2}$, 2, $2\frac{1}{2}$, 3 and 4 inch stretch measure mesh.

Other available information on the lakes was assembled from U. S. Forest Service maps, aerial photos, previous surveys and past planting records.

Findings:

A short, general description of the Clearwater drainage is given in the first section of this report. These five lakes, which contain over 90 percent of the lake acreage in this drainage, are in the mountainous terrain of the Lolo National Forest. Their drainage areas consist largely of lodgepole pine with considerable larch and less Douglas fir. Their shorelines are mostly brush and gravel with some weedy and silty areas. They range in depth from Salmon at 61 feet to Seeley at 119 feet, and in size from Inez at 293 acres to Placid at 1,143 acres. While the trout fishing has been considered poor on them for some time, they rank high in sportsmen interest and constitute perhaps the best potential lake fishery in this section of the district. The Department has been under pressure for some time to institute various management measures on them and many have been tried in the past. These have consisted mainly of planting various species of fish and of rough fish removal by trapping. Because of the extremely limited success of partial rough fish control in general, and further because there was no provision for evaluating its success here, trapping was stopped several years ago. However, perhaps because rough fish control is a measure which is readily observed and the general idea is appealing, the sportsmen are overwhelmingly convinced of its value and the Department is under constant pressure to re-institute it. So far this has been avoided, and the sportsmen on Placid Lake now propose to carry it out on that lake on their own.

Previous plantings have followed no general plan, nor has there been any basis for evaluating them other than fishermen's ideas of their relative success, admittedly a very poor criterion for comparison. Although plantings have differed from year to year, they have in general not differed greatly from lake to lake. Since, plantings of some sort must continue, due to public pressure, until their value is known, it was decided to vary the available plants in different lakes so

that there would be some basis for their evaluation. The program which was in operation at the time of this decision consisted of planting approximately twenty per acre cutthroat trout yearlings in all of the lakes except Salmon. This lake had been excluded because it was generally assumed that it had a much higher rough fish population than any of the rest.

The present plan calls for experimental plants of 200 per acre cutthroat yearling in Inez and 500 per acre cutthroat fry in Alva for comparison. The other three lakes are to receive from 100 to 200 per acre cutthroat fry, depending upon the availability of cutthroat eggs at the spawning stations. None will be planted at less than 100 per acre and should the supply of fry fall below that required for this figure on these three lakes, one or more of them will not be planted.

In order to evaluate these measures, the best possible figures of population indices for these lakesshould be taken at the present time. Because the netting done in 1954 was not extensive enough for a detailed comparison, it was analyzed mainly from the standpoint of setting up a more extensive program next season.

The netting results are presented three ways: total catch by numbers and weights in Tables No. 1 and 2, catch per net night by numbers and weights in Tables No. 3 and 4, and percent of total catch by numbers and weights in Tables No. 5 and 6. These data are furthur summarized as percent of rough and percent of game fish by weight and are presented along with number of sets, date of survey, and anglers' catch per hour of game fish in Table No. 7.

Table 1.
Total Catch by Numbers

Lake	Squaw Fish	Col. R. Chub	Sucker	Yellow Perch	Sun-fish	White-fish	Trout	Total
Salmon	44	32	27	35	0	14	5	157
Seeley	30	37	10	46	1	10	16	150
Placid	13	94	13	0	10	17	8	155
Inez	14	3	7	56	0	20	5	105
Alva	23	1	8	3	0	29	6	70

Table 2.
Total Catch by Weights

Lake	Squaw Fish	Col. R. Chub	Sucker	Yellow Perch	Sun-fish	White-fish	Trout	Total
Salmon	11.39	12.75	21.86	3.34	0.00	4.26	5.26	58.86
Seeley	11.39	18.31	13.79	5.96	0.38	3.24	6.12	59.19
Placid	7.91	46.85	18.62	0.00	2.01	4.80	8.30	88.49
Inez	5.26	2.58	4.88	5.34	0.00	10.82	4.00	32.98
Alva	10.63	0.26	5.67	0.88	0.00	10.55	6.32	34.31

Table 3.
Catch Per Net Night by Numbers

Lake	Squaw Fish	Col. R. Chub	Sucker	Yellow Perch	Sun-fish	White-fish	Trout	Total
Salmon	11.0	8.0	6.8	8.8	0.0	3.5	1.3	39.3
Seeley	12.3	10.0	3.3	15.3	0.3	3.3	5.3	50.0
Placid	4.3	31.3	4.3	0.0	3.3	5.7	2.7	51.6
Inez	4.7	1.0	2.3	18.6	0.0	6.7	1.7	35.0
Alva	5.8	0.3	2.0	0.8	0.0	7.3	1.5	17.5

Table 4.
Catch Per Net Night by Weights

Lake	Squaw Fish	Col. R. Chub	Sucker	Yellow Perch	Sun-fish	White-fish	Trout	Total
Salmon	2.8	3.2	5.5	0.8	0.0	1.1	1.3	14.7
Seeley	3.8	6.1	4.6	2.0	0.1	1.1	2.0	19.7
Placid	2.6	15.6	6.2	0.0	0.7	1.6	2.8	29.5
Inez	1.8	0.9	1.7	1.8	0.0	3.6	1.3	11.0
Alva	2.7	0.1	1.4	0.2	0.0	2.6	1.6	8.6

Table 5.
Percent Composition of Catch by Numbers

Lake	Squaw Fish	Col. R. Chub	Sucker	Yellow Perch	Sun-fish	White-fish	Trout	Total
Salmon	28.0	20.4	17.2	22.3	0.0	8.9	3.2	100.0
Seeley	20.0	24.7	6.7	30.7	0.7	6.7	10.7	100.2
Placid	8.4	60.6	8.4	0.0	6.5	11.0	5.2	100.1
Inez	13.3	2.9	6.7	53.3	0.0	19.0	4.8	100.0
Alva	32.8	1.4	11.4	4.3	0.0	41.4	9.6	99.9

Table 6.
Percent Composition of Catch by Weights

Lake	Squaw Fish	Col. R. Chub	Sucker	Yellow Perch	Sun-fish	White-fish	Trout	Total
Salmon	19.4	21.7	37.1	5.7	0.0	7.2	8.9	100.0
Seeley	19.3	30.9	23.3	10.1	0.6	5.5	10.3	100.0
Placid	8.9	52.9	21.0	0.0	2.3	5.4	9.4	99.9
Inez	15.9	7.8	14.8	16.2	0.0	33.2	12.1	100.0
Alva	31.0	0.8	16.5	2.6	0.0	30.7	18.4	100.0

Table 7.
Comparison of Anglers' Catch per Hour of Game Fish, Gill Net Catch, Percent Rough and Game Fish by Weight, and Time of Survey

	1953 CREEL CENSUS		1954 GILL NETTING				
Lake	No. of Fish Recorded	Catch/Hour of Trout	No. of Sets	Total Weight of Catch-lbs.	% Rough Fish	% Game Fish	Date of Survey
Salmon	87	1.0	4	58.86	83.8	16.2	6-8&9
Seeley	11	1.6	3	59.19	84.2	15.8	6-10&11
Placid	27	1.3	3	88.49	85.2	14.8	6-9&10
Inez	27	0.9	3	32.98	54.8	45.2	7-8&9
Alva	29	0.8	4	34.31	50.8	49.2	7-9&10-3sets 11-14&15-1set

Recommendations:

Significance tests were not applied to these data because it was not felt that the original netting was extensive enough to warrant such application. However, statistical analysis is not needed to note that although catches of individual species varied greatly in all the lakes, there is a remarkable similarity in the percent game and percent rough fish in the catches from the three larger lakes, Salmon, Seeley and Placid. This is an interesting comparison and seems to refute the prevailing opinion that Salmon Lake is more heavily infested with rough fish than any of the others. This same similarity can be noted by a comparison of the two smaller lakes, Alva and Inez. It is also quite apparent that there is a great dissimilarity between the two groupings of lakes, the three larger and the two smaller in this same respect. However, due somewhat to the small amount of netting on which these data are based, and more so to the different times of year that the two lakes were sampled, it cannot be said that this dissimilarity represents any great difference between the percent rough and percent game fish in the two groups of lakes. It is much more likely that it is merely a reflection of two of the limitations to the use of gill nets for obtaining indices of relative populations in different lakes, namely that gill nets are passive fishing gear which depend on fish movement for their catch and this movement can vary with the season and with the weather.

It would not be possible to completely remove these two limitations even by a very extensive netting on these lakes with only one survey crew. If, as is the standard practice, these lakes were netted consecutively, it is certain that the last lake would be netted during a different season than the first and therefore quite probably during a different catch rate period. With only one crew, the alternative to consecutive netting would be to net the whole series alternatly in rotation. That is, lift one one lake and set in another the same day, going from one lake to the next, until the required number of sets had been made in all. While this would greatly reduce the limitation due to seasonal variations, it would mean an appreciably increased amount of work for the crew; and it is still probable that differences in weather and their possible effect on fish movement would impair the validity of the data collected.

Therefore, it is recommended, in order to obtain the best possible population indices for comparison of these lakes, that they be netted simultaneously by five crews. Because it will be imperative that uniform methods be used on all the lakes, the following recommendations are made for the project:

1. To insure the crews being familiar with all phases of lake survey and sampling procedures, the present biological personnel in the fisheries division should be used, and not temporary help.

2. The Minnesota figures, given in Moyle, et. al. (1950), for the required number of gill net sets to be used in sampling lakes of various sizes should be used. The plan should be setup so that all the lakes are netted for the same number of days; that is, to obtain more sets on one lake than another, more nets should be used on the larger lake rather than netting a greater number of days with the same number of nets. Because the Minnesota set requirements are for 250-foot nets, while Montana uses mainly 125-foot nets, several 250-foot net sets should be made in addition to the required number of 125-foot sets for comparison.

3. The project leader should make several both deep and shallow water sets the week prior to the netting program to determine the advisability of using deep water sets at this time of year.

4. Net sets in the littoral zone should progress around the lake so that all parts of the littoral zone are sampled.

5. Large scale outline maps of the lakes should be prepared prior to the netting so that each crew can record the location of all sets.

6. To insure daily sets being made for approximately the same number of hours in each lake, all crews should use the daily schedule of lifting all nets, working the fish and mending the nets where necessary before any of the nets are reset.

7. Scale samples should be taken from up to 50 of each species (all rough fish as well as all game fish), and individual lengths and weights should be taken from all fish captured.

8. Lakes should be compared on the basis of gill net ratios, percent composition of the catch and growth rates of species.

While the information gained from this proposed project may prove useful in developing immediate management measures, its main value will lie in the future when this project is repeated, as a basis for evaluating the various stocking ratios, and whatever other management measures have been instituted on these lakes. It is realized that in repeating this operation in another year, both weater and time of season may well impose their limitations on the comparisons of one lake between two years. However, it is felt that the comparison of the relation of one lake to another in one year, to that same relation in another year will not be so seriously affected by these limitations.

Summary:

1. One overnight set was made with four nets in Salmon on June 8, with three nets in Placid on June 9, with three nets in Seeley on June 10, with three nets in Inez on July 8, with three nets in Alva on July 9, and with one net in Alva on November 14.

2. The netting results are presented by species and totals as total catch, catch per net night, and percent composition of the catch. The lakes are further compared on the basis of percent rough and percent game fish in the net catches, anglers' catch per hour of game fish, and dates of survey.

3. Although the catches of various species was different even in lakes netted approximately at the same time, the percent rough to percent game fish varied mainly in relation to the time of survey. The present data is not extensive enough for detailed comparisons of the fish populations.

4. The planting program has been revised to concentrate planting effort on cutthroat yearlings at 200 per acre on Inez, and on cutthroat fry at 500 per acre on Alva. The Placid Lake Sportsmen's Club proposes to do rough fish control by trapping on that lake.

5. In order to evaluate these measures it is desirable to obtain the best possible population indices of the various species in these lakes at the present time. To eliminate the effect of weather and season on the comparison figures, it is proposed to net all five lakes at the same time.

6. Five survey crews are to be used for this project and the following recommendations are made to insure further uniformity of the data collected.

a. The present biological personnel who are familiar with lake survey methods are to be used.
b. The Minnesota figures for the number of gill net sets to be made in lakes of various sizes should be used to determine the set requirements on each lake.
c. Both deep and shallow water sets should be made just prior to the main netting program to determine the ratio of these two types of sets to be used.
d. All parts of the littoral zone should be sampled.
e. Outline maps should be furnished for recording the locations of all net sets.
f. The daily schedule of lifting nets, working fish, repairing nets, and resetting nets should be used by all crews.

g. Scale samples from up to 50 fish of each species, and individual lengths and weights from all fish caught should be taken.
h. Comparisons should be made on the basis of gill net ratios, percent composition of the catch and growth rates of species.

7. It is expected that the main value of the information gained from the recommended project would be in the future when the project is repeated as a basis for the evaluation of the management measures which may have been applied. While weather and season would affect comparison of one lake in two years, they would have far less effect on the comparison of the relation of one lake to another in one year, to that same relation in another year.

Data and Reports:

The original data and reports are with the project leader at Missoula. Duplicate file cards of the survey information taken will be filed at the Helena office.

Literature Cited:

Moyle, John B., Jerome H. Kuehn, and Charles R. Burrows
1950. Fish population and catch data from Minnesota lakes. Trans. Am. Fish. Soc., Vol. 78 (1948), pp. 163-175.

Prepared by A. N. Whitney Approved by ____________

Date April 12, 1955

JOB COMPLETION REPORT

INVESTIGATIONS PROJECTS

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State of Montana

Project No. F-12-R-1 Job No. I

Title of Job: Cataloging the Waters of the Project Area

Abstract:

Survey emphasis was placed on the Clearwater drainage and a total of ten lakes and thirteen streams were surveyed in the project area. Information is being transferred from field records to permanent file cards, and a second set will be prepared for the Helena office.

The surveys of five Clearwater lakes and of six streams tributary to the upper Bitterroot River are treated in separate sections of this report.

It is recommended that survey work be continued, but that for the present time the work plan be rewritten to include the important waters of the project area rather than all the waters of a specific drainage.

Objectives:

To catalog the waters of the project area from the standpoint of physical and chemical characteristics and from the standpoint of fish response to the environment.

Techniques Used:

This year, the survey of the waters of the project area was concerned chiefly with the Clearwater drainage. As there was opportunity to do so, observations were also made on other waters of the project area. Names, locations, acreages, and lengths of streams and lakes were taken from U. S. Forest Service maps and aerial photographs. Stream flows were taken from U.S.G.S. flow data and from field measurements. Fish populations were sampled in all of the surveyed lakes with gill nets, and in most of the surveyed streams with an electric fish shocker. Scale samples were taken from important species of fish collected and sent to the Department's fishery laboratory for age and growth analysis. Information was recorded on field survey and netting forms and is being transferred to special file cards. A second copy of these will be made and sent to the Helena office.

Findings:

A total of ten lakes and thirteen streams were surveyed during the 1954 season, of which seven lakes and three streams were in the Clearwater drainage. Fish populations were sampled on all of the lakes and on eight of the streams.

The Clearwater River rises at the outlet of Clearwater Lake at approximately 4,800 feet above sea level, near the Clearwater-Swan divide. It flows about 40 miles in a southerly direction through Lakes Rainey, Alva, Inez, Seeley, and Salmon to its junction with the Big Blackfoot River at an elevation of slightly less than 3,800 feet above sea level. Fifteen lakes in the drainage have a total surface acreage of approximately 3,800 acres, however over 90% of this acreage is contained in the five main lakes: Alva, Inez, Seeley, Salmon and Placid. Four of these are accessible by a good blacktop highway, and one (Placid) is accessible by a good gravel road. They are all within about 50 miles of Missoula by good roads. They represent perhaps the best potential lake fishery in this section of the district, and while fishermen complain of poor fishing on them at present, the lakes rank high in their interest. The Department has been under considerable pressure for a number of years to try various management measures on them. Because of their importance, considerable survey time was spent on them, and they are covered in a special section of this completion report.

In September 1952, a survey crew sampled the fish populations in six streams in the upper Bitterroot River drainage. Five of the streams had been closed to fishing under the old idea of "feeder" streams. They were inventoried with the understanding that part of them would remain closed and part would be opened to fishing, then all would be resampled within one or two years. These streams were reinventoried this year during October, and because they represent a special problem, they are treated in a separate portion of this report.

Following is a list of lakes and streams surveyed and the data taken:

Lakes: Seeley, salmon, Placid, Alva, Inez, Clearwater, Harpers - physical and chemical data and population sample. Upsata and Unnamed Lakes - physical data and population sample. Brown's Lake - population sample.
Streams: Hughes Creek, Moose Creek, West Fork Bitterroot River, Skalkaho Creek, Burke Creek, Cottonwood Creek - physical data and population sample. Bear Creek and Clearwater River - physical data. Bitterroot River - chemical data.

Analysis and Recommendations:

Physical, chemical and biological data gained through survey is essential to the proper management of the waters of the project area and it is recommended that survey work be continued. However, survey by specific drainage requires that much time be spent on relatively unimportant waters, while important waters in other drainages of the project area receive no attention for several years. It is realized that information on all waters, both good and bad, is essential, a long range objective, but because of the present system of survey by specific drainage is delaying the survey of important waters in other drainages, it is recommended for the present that the survey work plan be rewritten to cover the more important waters of the project area in all drainages. Relative importance of fishing waters is determined largely by fishermen interest, and because fishermen interest usually manifests itself as a request for fish planting, the waters on the present planting program can be taken as a list of the more important fishing waters of the project area.

Summary:

Survey information on waters was collected from U.S.F.S. maps, aerial photographs, US.G.S. records and field work. This survey work was concentrated in the Clearwater drainage, and ten lakes and thirteen streams were surveyed during the 1954 season. Fish populations were sampled in all the lakes and on eight of the streams. Scale samples are at the Department's fishery laboratory

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for age and growth determinations.

Information is being transferred from field survey sheets to permanent file cards, and a second set of these cards will be prepared for the Helena office.

Because of specific problems, the surveys of five main Clearwater Lakes and six streams tributary to the upper Bitterroot River are treated in separate sections of this report.

It is recommended that the survey project be rewritten to concern the moreimportant waters of the project area rather thanall the waters of a specific drainage.

Data and Reports:

The original data and reports are with the project leader in Missoula. Second copies of the lake and stream survey cards will be filed in the Helena office.

Prepared by Arthur N. Whitney   Approved by ____________

Date May 1, 1955

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JOB COMPLETION REPORT
INVESTIGATIONS PROJECTS

State of Montana

Project No. F-12-R-1 Job No. I

Title of Job: Cataloging the Waters of the Project Area: Bitterroot Drainage Electric Fish Census

Abstract:

Six streams, five closed and one open to fishing, were inventoried in the fall of 1952. Three of these streams were opened to fishing in 1953 and 1954, and the same sections of the same six streams were re-inventoried in the fall of 1954.

A general decline in fish taken was noted from 1952 to 1954 on all but the one stream which had been open to fishing prior to 1952. This general decline is attributed to the fact that the 1954 inventory was at a later date than the 1952. There was a somewhat greater decline in fish taken from the three opened streams than from the two which had remained closed, and this was more apparent by weights of fish than by numbers.

The T test for significance of the difference between two means was applied to the data and it was found that by numbers, differences as great or greater than those observed could be expected to occur over 50 percent of the time, while by weights this could be expected only 5 to 10 percent of the time.

Other factors than fishing pressure could have affected these differences; however even if it is assumed that the weight difference was due to fishing pressure, there is no basis for retaining the closed streams as a management measure. Cutthroat and Dolly Varden trout were present in all six streams at both inventories, and in the unfished streams they are adding nothing to the fishing of the area.

Because further information is desirable on both the populations in fished and unfished streams, and also on the general decline in fish noted with time of sampling, it is recommended that the two closed streams remain closed this next year; and that all six streams be re-inventoried in 1955 at the same time of year as the 1952 sampling and, if time permits, again in 1955 at the same time as the 1954 sampling.

It is further recommended that when time and funds permit, a project be experimentally designed to reduce the limitations of these data, and to show the true effect of fishing pressure on cutthroat populations in these or other streams.

PLEASE RETURN

Objectives:

To catalog the waters of the project area from the standpoint of physical and chemical characteristics and from the standpoint of fish response to the environment. Specifically in this case, the original objective was to obtain population samples from several closed streams in order to help evaluate the worth of these closed streams in the fishery management of the Bitterroot drainage. The later objective in resampling was to try to determine the effect of fishing on the fish populations of three streams in this drainage.

Techniques Used:

On September 26, 27, and 29, 1952, six streams were sampled in the upper Bitterroot drainage. Of these, five were closed to fishing and one was open. One 300-foot section was chosen on each stream for accessibility. Each section was blocked with nets, and fish were collected with a 220 volt AC shocking device. Fish collected were counted, weighed, and measured. Scale samples were taken from trout and sent to the Department's fishery laboratory for age and growth analysis. Three of the five closed streams were opened to fishing in 1953 and 1954 while two of them remained closed.

On October 13, 14, and 27, 1954, the same 300-foot sections of these six streams were again sampled by the same method. The project leader from the northwest district, who did the 1952 shocking, assisted in the 1954 shocking to insure locating the same sections as before. The fish collected from the four streams sampled on October 13 and 14 were treated in the same manner as those collected in 1952. The ones taken from the two streams sampled on October 27 were counted, measured, and scale sampled, but were not weighed.

Findings:

Table No. 1 shows names and locations of streams sampled, and the 1952 and 1954 catches by numbers and species. Table No. 2 gives the 1952 and 1954 catches by weights for the streams on which weights were taken both years. It is readily apparent from an examination of this information that, with one exception, the total catch declined in both the opened and closed streams. The exception is Skalkaho Creek, which was open to fishing prior to 1952 and has remained open. The only explanation that can be offered for this general decline is that the streams were inventoried later in the season in 1954 than in 1952. During the 1954 sampling, water temperatures ranged from 41 to 32^{o}F. with most of the streams around the lower figure. Some ice was forming on exposed boulders and along the edges of the streams. Unfortunately, temperatures were not taken during the 1952 inventory; but it is probable, from the fact that this sampling was done from two weeks to one month earlier, that they were considerably higher. It is possible that a general winter decline, as noted in brown and rainbow trout by Stefanich (1952) on Prickley Pear Creek, had already started on these streams at the time of the 1954 sampling.

It can be noted from consideration of the weight data of Table No. 2, that although there was a decline in catch on all streams which had been opened to fishing than those on which had not. The same is true to a lesser degree in Table No. 1, although not so apparent from preliminary consideration of the data by numbers of fish. Tables No. 3 and 4 show this decline as percent drop from the 1952 figures, by numbers and weights respectively. The mean expressed here is the actual mean of the various percent drops (unweighed), and not the percent of total drop (weighed).

Table 1.
Streams, Locations, and Catch by Numbers and Species,
1952 and 1954 Shocking

(Hughes, Moose, and South Fork Skalkaho were closed through 1952 and opened in 1953 and 1954. Meadow, and West Fork Bitterroot have remained closed through 1954. Skalkaho Creek was opened before 1952 and remained open.)

Location	Species	Numbers of Fish Caught 1952	1954
Hughes Creek T3S, R21W, S2; Ravalli County	Cutthroat	61	17
	Dolly Varden	0	1
	Eastern Brook	1	1
	Whitefish	27	13
	Total	89	32
Moose Creek T2N, R17W, S16; Ravalli County	Cutthroat	26	12
	Dolly Varden	25	9
	Total	51	21
South Fork Skalkaho T5N, R18W, S29; Ravalli County	Cutthroat	31	17
	Dolly Varden	9	10
	Total	40	27
Meadow Creek T2N, R18W, S35; Ravalli County	Cutthroat	72	50
	Dolly Varden	48	47
	Total	120	97
West Fork Bitterroot T3S, R21W, S10; Ravalli County	Cutthroat	78	22
	Dolly Varden	17	4
	Eastern Brook	12	9
	Whitefish	12	9
	Suckers	16	0
	Total	135	44
Skalkaho Creek T5N, R19W, S27; Ravalli County	Cutthroat	13	12
	Dolly Varden	6	9
	Rainbow	2	1
	Total	21	22

Table 2.
Streams, Locations and Catch by/Weights, 1952 and 1954 Shocking

(Hughes and Moose were closed through 1952 and opened in 1953 and 1954. Meadow and West Fork Bitterroot were closed prior to 1952 and have remained closed.)

Location	Species	Weights of Fish Caught 1952	1954
Hughes Creek	Cutthroat	6.87	1.55
T3S, R21W, S2;	Dolly Varden	0.00	0.06
Ravalli County	Eastern Brook	0.36	0.03
	Whitefish	3.95	1.89
	Total	11.18	3.53
Moose Creek	Cutthroat	3.39	1.32
T2N, R17W, S16;	Dolly Varden	0.89	0.29
Ravalli County			
	Total	4.28	1.61
Meadow Creek	Cutthroat	8.90	6.14
T2N, R18W, S35;	Dolly Varden	1.88	1.27
Ravalli County			
	Total	10.78	7.41
West Fork Bitterroot	Cutthroat	11.67	6.57
T3S, R21W, S10;	Dolly Varden	2.24	0.92
Ravalli County	Eastern Brook	1.16	0.36
	Whitefish	0.35	1.62
	Suckers	2.11	0.00
	Total	17.51	9.47

Table 3.
Percent Decline in Numbers of Fish Caught, 1952 to 1954

$$\text{Percent Decline} = \frac{\text{1952 Catch} - \text{1954 Catch}}{\text{1952 Catch}}$$

Stream	All Fish	CT and DV	CT Only
	Fished Streams		
Hughes	64.0	70.4	72.1
Moose	58.8	58.8	53.8
S. Fk. Skalkaho	32.5	32.5	45.2
Mean	51.8	53.9	57.0
Weighed Mean	55.6	56.6	61.0
	Unfished Streams		
Meadow	19.2	19.2	30.6
W. Fk. Bitterroot	67.4	72.6	71.8
Mean	43.3	45.9	51.2
Weighed Mean	44.7	42.8	52.0

Table 4.
Percent Decline in Weights of Fish Caught, 1952 to 1954

$$\text{Percent Decline} = \frac{\text{1952 Catch} - \text{1954 Catch}}{\text{1952 Catch}}$$

Stream	All Fish	CT and DV	CT Only
	Fished Streams		
Hughes	68.4	76.6	77.4
Moose	62.4	62.4	61.0
Mean	65.4	69.5	69.2
Weighed Mean	66.8	71.1	72.0
	Unfished Streams		
Meadow	31.3	31.3	31.0
W. Fk. Bitterroot	45.9	46.2	43.7
Mean	38.6	38.8	37.4
Weighed Mean	40.3	39.7	38.2

While it is not customary to average percentages, in this case the T test for significance of the difference between two means was applied, which uses the differences of each variant from the group mean; and it was felt that the unweighed mean would give a better application to this formula than would the weighed one. The percent difference of the total decline (weighed mean) is also given on these tables for comparison. This T test[1] was applied to the following groupings of the data: All fish, numbers and weight; cutthroat and Dolly Varden, numbers and weight; and cutthroat only, numbers and weight. The values of T with their approximate probability levels are given on Table 5.

Recommendations:

From consideration of the probability levels on Table 5, it can be seen that by numbers, the actual difference in means could be expected to be exceeded over 50 percent of the time due to sampling error. Therefore, the somewhat greater percent drop in numbers of fish in the streams which were opened to fishing, over that on the streams which remained closed, is not indicative of any greater drop in population in the opened streams than in the closed ones. However, there is a high probability (90-95 percent) that the greater drop in weight on the opened streams than on the closed ones is indicative of a difference in population drop on these streams. It cannot be said that this is due solely to fishing pressure however, because the original sampling was not set up with statistical analysis in mind, and there are other differences than fishing pressure that may have had an effect on the populations sampled in the various streams. For example: Sections were not randomly selected; only one section was chosen on each stream; some of the streams appear to have different populations than others; the two streams with the highest original populations were retained as closed streams; and the two inventories were not made at the same time of year. However, these limitations of the data do not invalidate them for the purpose of the original inventory, which was merely to obtain population samples from closed and opened streams in order to demonstrate the relative value of retaining closed waters in this area. Consideration of these data certainly shows that the game fish populations were not completely removed in the opened streams; and even if we assume that the greater weight reduction on the two opened streams than on the two closed ones was due to fishing pressure, we still have no basis for keeping them closed. The feeder stream idea is not generally considered a valid management measure. Although fishing may have reduced the total weight of the population somewhat, the slightly higher weight populations in the closed streams are adding nothing to the fishing of the area, while the populations in the opened streams are. Therefore, from a management standpoint it should be recommended that the remaining closed waters be opened to fishing.

1/ $$T = \frac{(\bar{X}_1 - \bar{X}_2)}{\sqrt{\frac{\sum(X_1 - \bar{X}_1)^2 + \sum(X_2 - \bar{X}_2)^2}{n_1 + n_2}} \times \sqrt{\frac{n_1 + n_2 + 2}{(n_1+1)(n_2+1)}}}$$

X_1 = Variants in first sample

X_2 = Variants in second sample

$\bar{X}_1$ = Mean of first sample

$\bar{X}_2$ = Mean of second sample

n_1 = degrees of freedom for sample 1

n_2 = degrees of freedom for sample 2

Table 5.
T Values and Approximate Probability Levels for Differences in Mean Percent Decline in Catch, 1952 to 1954, of Fished and Unfished Streams

By Numbers of Fish
(Three Fished and Two Unfished Streams)

Species	T	Probability (Three Degrees of Freedom)
All Fish	0.3875	Greater than 50%
CT and DV	0.3250	Greater than 50%
CT Only	0.0811	Much Greater than 50%

By Weights of Fish
(Two Fished and Two Unfished Streams)

Species	T	Probability (Two Degrees of Freedom)
All Fish	3.3821	Between 5 and 10%
CT and DV	2.9847	Slightly more than 10%
CT Only	3.0671	Between 5 and 10%

The only limitation in these data which can be most easily eliminated is that of time of sampling. While the amount of effort that can be expended on this problem at present will not permit removal of all the present limitations in the data, it is felt that further comparison figures on these streams made at the same time of year would be desirable. This would be true both from the point of view of comparing fished and unfished streams, and also from the standpoint of gathering more data on the general drop in catch noted on both groups of streams with a later sampling date. Therefore, it is recommended that the two streams remain closed this next year, and that at the minimum, the same sections be sampled in 1955 at the same time of year as the 1952 inventories. Then, if time permits, that they be sampled again in 1955 at the same time as the 1954 inventory.

Because it is suspected that the cutthroat trout is a more gullible fish than other trout and therefore, fishing pressure may have a greater effect on this species, it would be well to design a series of inventories to show this effect. It is therefore recommended that, when time and funds permit, statistical counsel be obtained for experimental design of a project on these, or other streams to show the effect of fishing pressure on cutthroat populations.

Summary:

1. One section each on six streams tributary to the upper Bitterroot River (One open and five closed to fishing) was inventoried by the electric shock method in September, 1952. Three of the closed streams were opened to fishing in 1953 and 1954 and the same sections of these six streams were re-inventoried by the same method in October, 1954.

2. A general decline in fish taken was noted from 1952 to 1954 on all but the one stream which had been open to fishing before 1952. This general decline was tentatively attributed to the later sampling date in 1954. There was a somewhat greater decline in fish taken from the three opened streams than from the two which had remained closed, and this was more apparent by weights of fish than by numbers.

3. This decline is expressed as percent drop and calculated by dividing the 1952 catch by the difference between it and the 1954 catch. This was computed by weights and numbers for the following data groupings: all fish, cutthroat and Dolly Varden, and cutthroat only. There was overlap in range between the percent declines in the opened streams and closed streams by numbers, but not by weight.

4. The T test for significance of the difference between two means was applied to the average percent declines of the opened as compared to the closed streams. It was found that by numbers, differences as great or greater than those observed could be expected to occur over 50 percent of the time due to errors of sampling. On the other hand, by weights this could be expected only 5 to 10 percent of the time.

5. It cannot be said that this high probability for differences in weights is due solely to fishing pressure because of the facts that sections were not randomly selected; only one section was chosen on each stream; some of the streams appear to have different species in their populations; the streams with the highest original populations were retained as closed streams; and the surveys were not made at exactly the same time of year.

6. Even if it is assumed that there is a weight difference due to fishing pressure in the populations of these streams, there is no basis for retaining the closed streams as a management measure. Cutthroat and Dolly Varden were present in all six streams at both inventories, and in the unfished streams they are adding nothing to the fishing of the area.

7. Because further information is desirable both on the populations in fished and unfished streams, and also on the general decline in fish noted with time of sampling, it is recommended that the two closed streams remain closed this next year, and that all six streams be re-inventoried in 1955 at the same time of year as the 1952 sampling, and if time permits again in 1955 at the same time as the 1954 sampling.

8. It is further recommended that when time and funds permit, a project be experimentally designed to reduce the limitations of these data and to show better the true effect of fishing pressure on cutthroat populations in these or other streams.

Data and Reports:

The original data and reports are with the project leader at Missoula. Duplicate file cards of the survey information taken will be filed in the Helena office.

Literature Cited:

Stefanich, Frank A.
1952. The population and movement of fish in Prickley Pear Creek, Montana. Trans. Am. Fish. Soc., Vol. 81 (1951), pp. 260-274.

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